VOL. VI, PART III. *Published* 1 *April* 1920

# The British Mycological Society

(*Recognosce notum, ignotum inspice*)

# TRANSACTIONS 1919

Edited by

CARLETON REA and J. RAMSBOTTOM

*Price to non-members*, 8/-



CAMBRIDGE
AT THE UNIVERSITY PRESS
1920

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*Elected September* 1919

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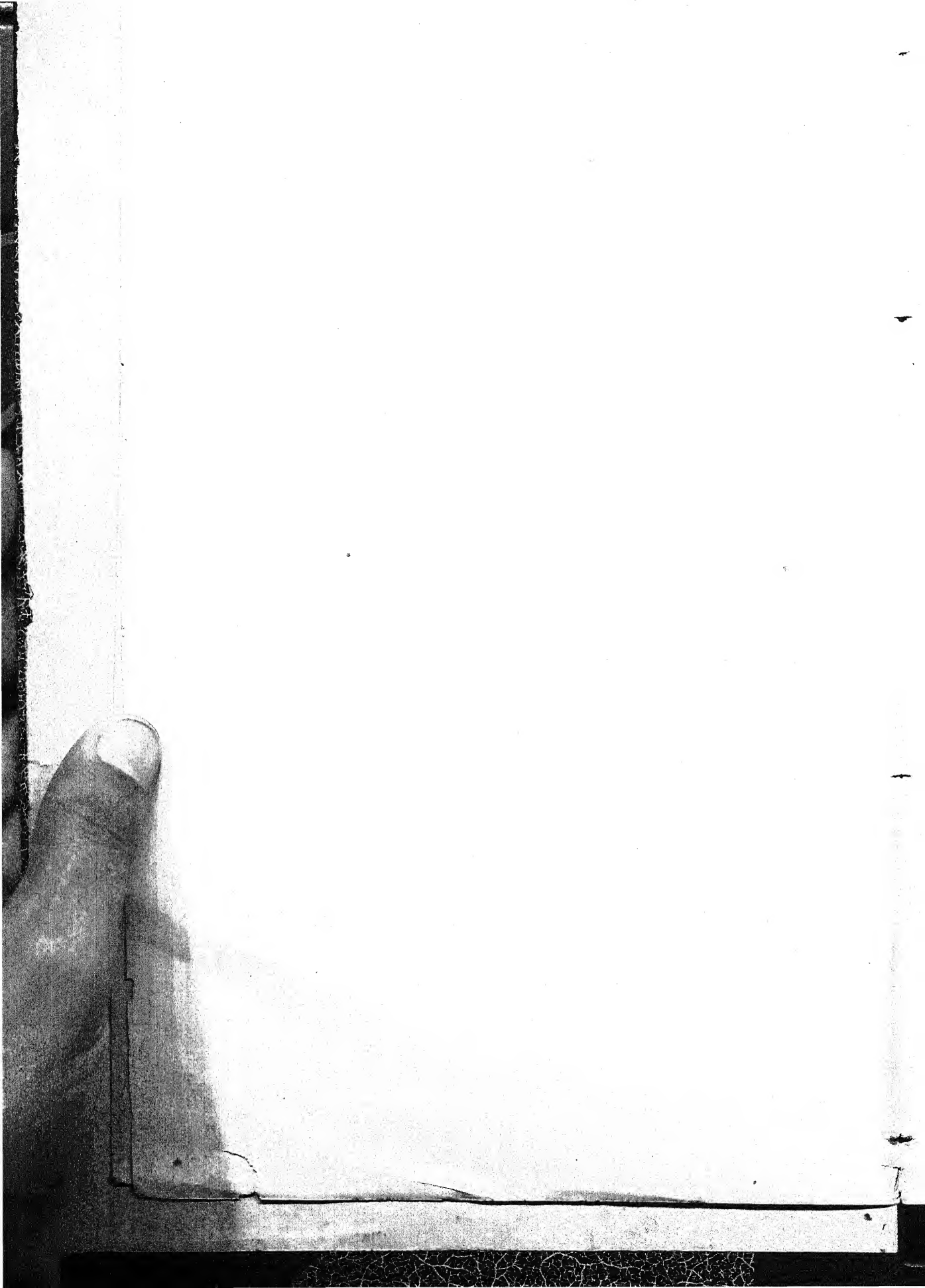
*The Transactions for* 1919 *will be published in two parts.*



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# THE BASLOW FORAY.

*22nd–27th September*, 1919.

The twenty-third annual week's Fungus Foray was held at Baslow, Derbyshire, from September 22nd to September 27th, 1919. This first post-war meeting was attended by some thirty-two members and visitors, and was in every way a most enjoyable one. Unfortunately however, not only in Derbyshire but generally, the autumn of 1919 was a bad season for fungi, consequently the list of species numbers only three hundred and ninety-one, as compared with the 1909 list of five hundred and thirty-three. The difference is the more marked when it is remembered that the number, three hundred and ninety-one, was only attained after practically a fortnight's work on the part of various members of the party. A few enthusiasts had spent the previous week-end at Baslow, and owing to the railway strike a number of members were held up for some days after the 27th, spending their time in adding as far as possible to the records for the Foray.

The headquarters for the meeting were at the Grand Hotel and Hydro, where the manager kindly placed at our disposal a large room for the exhibition of specimens and the holding of meetings.

Here on the Monday evening various fungi of interest brought by members were placed on exhibition. Dr Adams* had brought from Keswick *Tricholoma imbricatum*, *Lactarius mitissimus*, *Cortinarius pholideus*, and *Boletus porphyrosporus*, and from Looe *Polyporus varius*. Mr Rea showed *Marasmius foetidus*, *Leptonia euchlora*, *Cortinarius caerulescens*, and *Lycoperdon velatum*, all from Tick Wood, Shropshire. Subsequently Mr N. G. Hadden sent from West Porlock *Boletus sulphureus* and *Paxillus panuoides*, both found growing on sawdust.

On Tuesday, September 23rd, the party started out through the Yeld Wood at the back of the Hotel, intending to make for some promising ground near a stream which had been noticed the previous day. Unfortunately however the way was missed, and instead we found ourselves on a high moorland, which yielded nothing but numerous specimens of *Anellaria separata*, growing on cow-dung. It was decided to attempt a short cut back to Baslow by climbing down, a proceeding which was

* Members will learn with deep regret that Dr Adams has since passed away. The Society is glad to welcome his son, Mr J. Adams, who was also present at Baslow, as a member.

found somewhat difficult, especially for the ladies, owing to the very rough nature of the ground. During this return journey the party became broken up, and various members succeeded in finding more suitable collecting ground in copses round the village, with the result that quite a fair number of species had been gathered by lunch-time. After lunch at the Hotel, a few members went out again, chiefly into the Yeld Wood, but others stayed in in order to sort and work out the specimens already collected. A piece of old sacking yielded *Botryotrichum piluliferum**, new to Britain, subsequently reported by Miss Lorrain Smith.

In the evening, the Annual General Meeting was held, the President, Dr Wager, occupying the chair. The Officers and Council for 1920 were elected (see p. 2 of cover) and the new Rules, with some slight amendments, chiefly verbal, were confirmed. Mr A. D. Cotton urged the necessity of the Society taking a more active part in the development of Plant Pathology in Great Britain, and suggested the formation of a special sub-committee to deal with questions of interest to plant pathologists. After a vigorous discussion the general opinion seemed to be that some steps should be taken to make it clear that the Society includes in its scope *all* branches of mycology, including pathology, but the details of action were left to be settled by the Council†.

After the adoption of the balance sheet for the year, the Treasurer pointed out that it may become necessary to raise the subscription in 1920, to meet the enormously increased cost of printing. Should this become necessary, due notice will be given before the next Annual General Meeting. It was resolved to publish the Transactions for the future in two half yearly parts.

Miss Lorrain Smith then showed a very interesting abnormal specimen of *Fomes ulmarius*, which had been found in a drain 30 feet below the surface of the ground.

On the following day, Sept. 24th, motors were in attendance at 10.0 a.m., and the party was taken first to Highlow Wood. This being a damp wood with much fallen timber lying about was specially productive of resupinate Hymenomycetes. Miss Wakefield collected the new species *Hypochnus roseo-griseus*, which was described for the first time last year. The Rev. C. Fynes-Clinton gathered a fine specimen of *Fomes conchatus*, and Mr Thos. Smith brought in *Dacryomitra glossoides*, which was also gathered at the 1909 Foray. Messrs Pearson and Rea

* For description see New or Rare Microfungi, to be published later.

† At a Council Meeting held December 17th, 1919, a sub-committee for plant pathology was constituted as follows: F. T. Brooks, M.A. (*Chairman*), A. D. Cotton, F.L.S. (*Secretary*), G. H. Pethybridge, B.Sc., Ph.D., J. Ramsbottom, M.A., F L.S., together with the President and Secretary of the Society *ex officio*.

secured *Mycena dilatata*, new to the British flora, and *M. chlorantha*. The party then motored back as far as Padley Wood, where a halt was made for lunch. Here a few interesting species were obtained, notably *Naucoria Cucumis*, and *Galactinia Phillipsii*, the latter discovered by Miss Noel. It is a beautiful Discomycete, remarkable for the large sculptured violet spores. Owing to the description of the spores as hyaline in Massee's "Fungus Flora," vol. IV, there was some discussion as to whether the colour had not diffused into the epispore from other parts of the fructification. The specimens examined however left no doubt that the spores are at first hyaline, but when mature are covered by a violet-coloured warted epispore. This confirms Phillips' original description as set out in *Grevillea*, IV. 84, for *Ascobolus amethystinus**.

Stoke Wood was then visited, and here the first fungus to be found was a large and beautiful group of *Clitocybe connata*, growing close to the gate. This wood proved to be poorest in species of the three visited, and the only other find of special interest was *Nolanea araneosa*, also recorded in 1909.

In the evening, at 9 o'clock, Dr Wager delivered his Presidential address, entitled "The Sexuality of the Fungi."

On Thursday, Sept. 25th, the party was conducted over the grounds of Chatsworth by the head forester, Mr J. P. Robertson. As was natural the greater number of the Agarics collected on this day were species characteristic of pastures. *Hygrophorus clivalis, Reai*, and *russo-coriaceus* were all noted by Mr Rea. It was particularly interesting to find *H. Reai* because it was first described from this locality at the Baslow Foray of 1909. *Merulius lacrymans* var. *minor* was found by Dr Bayliss Elliott, while some other noteworthy species observed were *Hypholoma pyrotrichum, Inocybe fastigiata, I. destricta* and *Corticium botryosum* growing on dead stems of *Pteris aquilina*.

At the evening meeting Mr. A. A. Pearson, F.L.S., read a paper on "Cystidia as a Generic Character" and Mr W. B. Brierley gave an account of "Mutations among Fungi," which evoked a good deal of discussion.

On Friday, Sept. 26th, in a heavy downpour of rain, Calton Lees wood-yard was first visited, but yielded only a few fungi. Mr Robertson then conducted the party to New Piece Wood, where *Lactarius fuliginosus* and *L. theiogalus* were perhaps the most interesting finds. After lunch at the Hotel some members paid a visit to Haddon Hall, the historical and romantic interest of which eclipsed mycology, for the only record brought in was *Puccinia Malvacearum*!

* There seems to have been some confusion as to the nomenclature of this species. It is hoped to publish a note on it in the next part.

In the evening the formal meeting was brought to a close by hearty votes of thanks to the owners and factors who had given permission for their woods to be visited, to Dr Wager for presiding, and to the Treasurer and Secretary for the general management of the meeting.

For assistance in compiling the subjoined list of species the Secretary is much indebted to Mr Carleton Rea, Miss A. Lorrain Smith, Dr Bayliss Elliott, Mr A. D. Cotton and Mr C. H. Grinling.

## COMPLETE LIST OF FUNGI GATHERED DURING THE FORAY.

*C.* = Chatsworth; *H.* = Highlow Wood; *P.* = Padley Wood; *S.* = Stoke Wood; *N.* = New Piece Wood, Chatsworth; *B.* = neighbourhood of Burbage Brook. Where not otherwise indicated the locality is the immediate neighbourhood of Baslow.

Amanita muscaria (Linn.) Fr., *H.*, *P.*, rubescens (Pers.) Fr., pantherina (DC.) Fr., *C.*

Amanitopsis vaginata (Bull.) Roze, *H.*, strangulata (Fr.) Roze.

Lepiota procera (Scop.) Fr., *C.*, rachodes (Vitt.) Fr., cristata (A. & S.) Fr., amianthina (Scop.) Fr., *H.*

Armillaria mellea (Vahl.) Fr.

Tricholoma rutilans (Schaeff.) Fr., *C.*, imbricatum Fr., terreum (Schaeff.) Fr., *C.*, argyraceum (Bull.) Fr., cuneifolium Fr., *H.*, carneum (Bull.) Fr., *C.*, album (Schaeff.) Fr., personatum (Fr.) Berk., *C.*, cinerascens (Bull.) Quél. (Syn. Clitocybe fumosa Fr.), melaleucum (Pers.) Fr., var. phaeopodium (Bull.) Quél.

Clitocybe clavipes (Pers.) Fr., rivulosa (Pers.) Fr., phyllophila Fr., candicans (Pers.) Fr., *H.*, dealbata (Sow.) Fr., var. minor Cooke, *C.*, connata (Schum.) Fr., *S.*, infundibuliformis (Schaeff.) Fr., *C.*, brumalis Fr., *Bolehill Wood*, metachroa (Fr.) Berk., *C.*, ditopus Fr., *H.*

Laccaria laccata (Scop.) Berk. & Br.

Collybia radicata (Rehl.) Berk., *S.*, platyphylla Fr., *S.*, fusipes (Bull.) Berk., maculata (A. & S.) Fr., *H.*, *C.*, butyracea (Bull.) Fr., vertirugis Cooke, *B.*, confluens (Pers.) Fr., *C.*, tuberosa (Bull.) Fr., *P.*, xanthopus Fr., acervata Fr., *P.*, dryophila (Bull.) Fr., ambusta Fr., *B.*, clusilis Fr., *Monsal Dale.*

Mycena olivaceo-marginata Mass., *C.*, pura (Pers.) Fr., *S.*, chlorantha Fr., *H.*, lactea (Pers.) Fr., *H.*, galericulata (Scop.)

Fr., polygramma (Bull.) Fr., ammoniaca Fr., metata Fr., *C.*, amicta Fr., *C.*, Iris Berk., *B.*, vitilis Fr., *B.*, sanguinolenta (A. & S.) Fr., galopus (Pers.) Fr., var. alba Fl. Dan., var. nigra Fl. Dan. (Syn. M. leucogala Cooke), *H.*, *P.*, epipterygia (Scop.) Fr., *P.*, rorida Fr., *P.*, pelliculosa Fr., *P.*, dilatata Fr.*, *H.*, tenerrima Berk., corticola (Schum.) Fr.

Omphalia umbellifera (Linn.) Fr., *P.*, velutina Quél., *C.*, fibula (Bull.) Fr., var. Swartzii Fr.

Pleurotus ulmarius (Bull.) Fr., *Great Longstone.*

Hygrophorus pratensis (Pers.) Fr., virgineus (Wulf.) Fr., *C.*, niveus (Scop.) Fr., russo-coriaceus Berk & Br., *C.*, clivalis Fr., *C.*, ovinus (Bull.) Fr., laetus (Pers.) Fr., *B.*, ceraceus (Wulf.) Fr., *C.*, coccineus (Schaeff.) Fr., *C.*, *B.*, miniatus Fr., *P.*, conicus (Scop.) Fr., Reai Maire, *C.*, psittacinus (Schaeff.) Fr., *B.*

Lactarius pubescens Fr., turpis (Weinm.) Fr., *B.*, blennius Fr., *C.*, quietus Fr., theiogalus Fr., *N.*, rufus (Scop.) Fr., glyciosmus Fr., fuliginosus Fr., *N.*, serifluus (DC.) Fr., *C.*, mitissimus Fr., subdulcis (Pers.) Fr., *H.*

Russula nigricans (Bull.) Fr., *S.*, *N.*, adusta (Pers.) Fr., furcata (Pers.) Fr., virescens (Schaeff.) Fr., *C.*, atropurpurea (Krombh.) Maire, vesca Fr., cyanoxantha (Schaeff.) Fr., *S.*, *N.*, foetens (Pers.) Fr., *C.*, fellea Fr., *N.*, emetica (Schaeff.) Fr., ochroleuca (Pers.) Fr., *B.*, *H.*, *N.*, fragilis (Pers.) Fr., *P.*, lutea (Huds.) Fr., *B.*

Cantharellus cibarius Fr., *C.*, aurantiacus (Wulf.) Fr.

Nyctalis parasitica (Bull.) Fr., *C.*

Marasmius peronatus (Bolt.) Fr., oreades (Bolt.) Fr., *C.*, ramealis (Bull.) Fr., rotula (Scop.) Fr., androsaceus (Linn.) Fr.

Lentinus cochleatus (Pers.) Fr., *H.*

Panus stypticus (Bull.) Fr., *C.*

Lenzites betulina (Linn.) Fr., *C.*

Pluteus cervinus (Schaeff.) Fr., nanus (Pers.) Fr., *S.*

Entoloma prunuloides Fr., *C.*, rhodopolium Fr., costatum Fr., sericeum (Bull.) Fr.

Leptonia lampropus Fr., *P.*, *C.*, sericella (Fr.) Quél., *S.*

Nolanea pascua (Pers.) Fr., *B.*, proletaria Fr., papillata Bres., araneosa Quél., *S.*

Eccilia griseo-rubella (Lasch.) Fr., *C.*

Claudopus variabilis (Pers.) W.G.Sm., *P.*

Pholiota erebia Fr., *S.*, togularis (Bull.) Fr., subsquarrosa Fr., *N.*, spectabilis Fr., mutabilis (Schaeff.) Fr., *Bolehill Wood*, marginata (Batsch) Fr.

* New to Britain. For description see New or Rare British Fungi to be published later.

Bolbitius titubans (Bull.) Fr., *C.*

Inocybe cincinnata Fr., *C.*, incarnata Bres., *B.*, *C.*, obscura (Pers.) Fr., *B.*, fastigiata (Schaeff.) Fr., *C.*, rimosa (Bull.) Fr., *B.*, *C.*, asterospora Quél., *B.*, *N.*, proximella Karst., *N.*, eutheles Berk & Br., *B.*, destricta Fr., *C.*, geophylla Fr.

Hebeloma fastibile Fr., glutinosum (Lindg.) Fr., *N.*, mesophaeum Fr., crustuliniforme (Bull.) Fr.

Flammula sapinea Fr., *H.*, *N.*, flavida (Schaeff.) Fr.

Naucoria Cucumis (Pers.) Fr., *P.*, melinoides Fr., *C.*, semiorbicularis (Bull.) Fr., *Froggatt Edge*, sobria Fr., *Bolehill Wood*, escharoides Fr.

Galera tenera (Schaeff.) Fr., hypnorum (Schrank) Fr., mycenopsis Fr., *C.*

Tubaria furfuracea (Pers.) W.G.Sm., paludosa Fr., *C.*, inquilina Fr., *Bolehill Wood.*

Cortinarius (Myxacium) elatior (Pers.) Fr., *P.*, *N.*

— (Dermocybe) tabularis (Bull.) Fr., *H.*, *N.*, caninus Fr.

— (Telamonia) torvus Fr., *P.*, hinnuleus (Sow.) Fr., *P.*, iliopodius Fr., *Bolehill Wood*, hemitrichus (Pers.) Fr., *Bolehill Wood*, rigidus (Scop.) Fr.

— (Hydrocybe) castaneus (Bull.) Fr., leucopus (Bull.) Fr., *C.*, decipiens (Pers.) Fr., *Bolehill Wood*, acutus (Pers.) Fr., *C.*

Paxillus involutus (Batsch) Fr., panuoides Fr., *C.*

Psaliota xanthoderma (Genev.) W.G.Sm., campestris (Linn.) Fr., *C.*, comtula Fr., *H.*

Stropharia aeruginosa (Curt.) Fr., *C.*, albocyanea (Desm.) Fr., inuncta Fr., *C.*, squamosa (Pers.) Fr., *C.*, merdaria Fr., *Froggatt Edge*, semiglobata (Batsch) Fr.

Hypholoma capnoides Fr., *N.*, epixanthum Fr., *P.*, fasciculare (Huds.) Fr., pyrotrichum (Holmsk.) Fr., *C.*, velutinum (Pers.) Fr., *S.*, leucotephrum Berk. & Br.

Psilocybe sarcocephala Fr., *Monsal Dale*, uda (Pers.) Fr., *C.*, semilanceata Fr., *C.*, foenisecii (Pers.) Fr.

Psathyra corrugis (Pers.) Fr., *C.*, fibrillosa (Pers.) Fr., conopilea Fr., *Froggatt Edge.*

Coprinus comatus (Fl. Dan.) Fr., atramentarius (Bull.) Fr., cinereus (Schaeff.) Fr., niveus (Pers.) Fr., micaceus (Bull.) Fr., plicatilis (Curt.) Fr., *S.*, *C.*, ephemerus (Bull.) Fr., *C.*

Panaeolus sphinctrinus Fr., campanulatus (Linn.) Fr., *C.*, papilionaceus (Bull.) Fr., *C.*

Anellaria separata (Linn.) Karst.

Psathyrella gracilis (Pers.) Fr., atomata Fr., *N.*, crenata (Lasch) Fr., *Bolehill Wood*, disseminata (Pers.) Fr., *S.*, *C.*

Boletus elegans (Schum.) Fr., *B.*, granulatus (Linn.) Fr., *C.*, badius Fr., *B.*, piperatus (Bull.) Fr., *C.*, chrysenteron (Bull.) Fr., subtomentosus (Linn.) Fr., *B.*, edulis (Bull.)

Fr., *B.*, *C.*, luridus (Schaeff.) Fr., *C.*, versipellis Fr., *Bolehill Wood*, scaber (Bull.) Fr., *P.*

Fistulina hepatica (Huds.) Fr., *C.*

Polyporus squamosus (Huds.) Fr., *C.*, and f. erecta Bres., *Calton Lees*, nummularius (Fr.) Quél., sulphureus (Bull.) Fr., *C.*, dryadeus (Pers.) Fr., *C.*, betulinus (Bull.) Fr., adustus (Willd.) Fr., *S.*, lacteus Fr., fragilis Fr., *H.*

Fomes connatus Fr., *H.*, annosus Fr., conchatus (Pers.) Karst., *H.*, ferruginosus (Fr.) Mass.

Polystictus versicolor (Linn.) Fr.

Poria mollusca (Pers.) Fr., *S.*, hymenocystis Berk. & Br., *H.*, sanguinolenta (A. & S.) Fr., *H.*

Merulius lacrymans (Wulf.) Fr., var. minor Falck, *C.*

Hydnum repandum (Linn.) Fr., *C.*, rufescens (Pers.) Fr., *C.*

Caldesiella crinalis (Fr.) Bourd. & Galz.

Irpex obliquus (Schrad.) Fr.

Phlebia merismoides Fr., *S.*

Odontia alutacea (Fr.) Quél., fimbriata (Pers.) Fr., farinacea (Pers.) Quél.

Grandinia granulosa Fr.

Stereum hirsutum (Willd.) Fr., purpureum (Pers.) Fr., spadiceum (Pers.) Fr., *C.*, sanguinolentum (A. & S.) Fr., rugosum (Pers.) Fr., *H.*

Corticium Sambuci (Pers.) Fr., *S.*, botryosum Bres., *C.*, subcoronatum von Hoehn. & Litsch., *B.*, confluens Fr., *H.*, confine Bourd. & Galz., *H.*, *S.*, *N.*, sulphureum (Pers.) Bres., *H.*, praetermissum (Karst.) Bres., *B.*, *H.*, porosum Berk. & Br., albo-stramineum (Bres.) Wakef., *H.*, *N.*

Peniophora pallidula Bres., *B.*, cremea Bres., *N.*, velutina (DC.) Cooke, *H.*, setigera (Fr.) Bres., *S.*, pubera (Fr.) Mass., *H.*, gigantea (Fr.) Mass., *N.*, aurantiaca Bres., *H.*, incarnata (Pers.) Cooke, *H.*, maculaeformis (Fr.) Bourd. & Galz., *B.*, cinerea (Fr.) Cooke, quercina (Pers.) Cooke, hydnoides Cooke & Mass., *H.*

Hypochnus zygodesmoides (Ell.) Burt, *N.*, roseo-griseus Wakef. & Pears., *H.*

Coniophora arida Fr., *B.*

Cyphella capula (Holmsk.) Fr.

Solenia anomala (Pers.) Fr., *C.*

Clavaria cristata (Holmsk.) Fr., cinerea (Bull.) Fr., corniculata (Schaeff.) Fr., *C.*, and var. pratensis (Fr.) Cotton & Wakef., fusiformis (Sow.) Fr., *C.*, acuta (Sow.) Fr., rugosa (Bull.) Fr., inaequalis (Müll.) Fr.

Pistillaria quisquiliaris Fr., *C.*

Tremella mesenterica (Retz.) Fr., *S.*

Dacryomyces deliquescens (Bull.) Duby, *S.*, *N.*

Calocera viscosa (Pers.) Fr., cornea (Batsch) Fr.
Dacryomitra glossoides (Pers.) Bref., *H.*
Phallus impudicus (Linn.) Pers., *H.*
Mutinus caninus (Huds.) Fr., *H.*
Sphaerobolus stellatus (Tode) Pers.
Crucibulum vulgare Tul.
Bovista plumbea Pers.
Lycoperdon depressum Bon., pyriforme (Schaeff.) Fr., *C.*, umbrinum Pers., *P.*, *C.*, perlatum Pers., *P.*
Scleroderma vulgare Hornem.
Puccinia Lychnidearum Link, *C.*, Malvacearum Mont., *Haddon Hall*, pulverulenta Grev., on *Epilobium hirsutum, Miller's Dale*, Valantiae Pers., on *Galium cruciatum, Miller's Dale*, obtegens (Link.) Tul., *C.*, Hieracii (Schum.) Mart., *C.*, Lampsanae (Schultz) Fuck., *C.*, Leontodontis Jacky, *Miller's Dale*, Menthae Pers., *N.*, obscura Schroet., *C.*, triticina Eriks., Poarum Niels. (Aecidium on *Tussilago*).
Phragmidium Sanguisorbae (DC.) Schroet., *Stoney Middleton.*
Coleosporium Tussilaginis (Pers.) Kleb., *C.*, Sonchi-arvensis (Pers.) Lév., on *Sonchus arvensis, Miller's Dale.*
Ustilago violacea (Pers.) Wint., on *Lychnis dioica.*
Frankiella Alni (Wor.) Maire, near saw-mill, Baslow.
Erysiphe communis (Wallr.) Fr., graminis (DC.) Fr.
Nectria cinnabarina (Tode) Fr.
Hypocrea rufa (Pers.) Fr., *Bolehill Wood.*
Hypomyces torminosus on *Lactarius pubescens.*
Cordyceps militaris (Linn.) Link, with the conidial stage also.
Xylaria polymorpha (Pers.) Grev., Hypoxylon (Linn.) Grev., *S.*, *N.*
Rhopographus Pteridis (Sow.) Wint., *C.*
Helvella crispa (Scop.) Fr., *S.*
Rhizina inflata (Schaeff.) Karst., *B.*
Aleuria micropus (Pers.) Gill., *H.* (*fide* Dr Bayliss Elliott).
Galactinia Phillipsii (Cooke) Boud., *P.*
Otidea cochleata (Linn.) Fuck., *S.*
Peziza aurantia Pers., *C.*
Ciliaria scutellata (Linn.) Quél., *S.*
Coprobia granulata (Bull.) Boud.
Ascobolus Crouani Boud., *C.*, stercorarius (Bull.) Schroet.
Leotia lubrica (Scop.) Pers., *N.*
Cudoniella acicularis (Bull.) Schroet.
Coryne sarcoides (Jacq.) Tul.
Bulgaria inquinans (Pers.) Fr.
Corynella glabro-virens Boud., *B.*
Orbilia xanthostigma Fr.
Ciboria Sydowiana Rehm.

Sclerotinia Curreyana (Berk.) Karst., *N.*
Phialea firma (Pers.) Gill.
Chlorosplenium aeruginosum (Oeder.) de Not., *S.*
Helotium fructigenum (Bull.) Fuck., cyathoideum (Bull.) Karst., *C.*, scutula (Pers.) Karst., virgultorum (Wahl.) Karst.
Dasyscypha Soppittii Mass., *C.*
Trichoscypha calycina (Schum.) Boud., *H.*
Hyaloscypha hyalina (Pers.) Boud., *C.*
Urceolella puberula (Lasch) Boud.
Mollisia cinerea (Batsch) Karst., benesuada (Tul.) Phill.
Stegia Ilicis Fr., *C.*
Rhytisma acerinum (Pers.) Fr.
Empusa muscae Cohn, *N.*
Phytophthora infestans (Mont.) de Bary, *C.*
Peronospora parasitica (Pers.) Tul., *C.*
Cystopus cubicus (Strauss) de Bary, *Monsal Dale*, candidus (Pers.) de Bary, on *Arabis*.
Spinellus fusiger (Link) van Tiegh., *C.*
Pilobolus crystallinus (Wiggers) Tode.
Phoma complanata (Tode) Desm., on *Heracleum*.
Cytospora Laurocerasi Fuck.
Septoria graminum Desm.
Leptothyrium acerinum (Kze) Corda on *Acer campestre*, medium Cooke.
Oidium alphitoides Griff. & Maubl., *C.*
Cylindrium flavo-virens (Dittm.) Bon.
Trichoderma viride (Pers.) Fr.
Sporotrichum chrysospermum Harz., *C.*
Sepedonium chrysospermum (Bull.) Fr., *N.*
Ramularia calcea (Desm.) Ces.
Echinobotryum atrum Corda, *H.*
Botryotrichum piluliferum Sacc. & March.* on old sacking, *Baslow*.
Gonytrichum caesium Nees, *C.*
Cladosporium epiphyllum Mart., fulvum Cooke, on Tomato, *Baslow Hydro*.
Stysanus stemonites Corda, *H.*
Volutella nivea (Fr.) Sacc.
Epicoccum purpurascens Ehrenb., *N.*

* New to Britain. For description see New or Rare Microfungi to be published later.

# MYCETOZOA FOUND DURING THE BASLOW FORAY.

*By Gulielma Lister, F.L.S.*

The visit of the British Mycological Society to Baslow had been arranged to take place from Monday, Sept. 22nd, to the following Saturday. Several of our party however arrived a few days earlier than the appointed time; and, owing to the railway strike, many were unable to leave at the end of the week; thus by the enforced extension of their visit a fuller opportunity was afforded for exploring the woods than had been anticipated. The weather for the previous weeks had been drier than the hunters for Mycetozoa could have wished, but on the whole a fair harvest of species was obtained.

On September 19th W. N. Cheesman searched some woods between Grindleford and Baslow, and found six species, including a good development of *Trichia verrucosa*. This species although it had been recorded from seven English counties, as well as from Wales and Scotland, is by no means common in the British Isles, and is a new record for Derbyshire. Mr Cheesman also obtained a fine gathering of *Cribraria rufa*.

On September 23rd the woods near Baslow were searched. These consisted of oak, ash, sycamore, poplar and beech, with some larch and Scots fir. Nineteen species were obtained. On fallen pine boughs *Didymium melanospermum* was abundant, and on the dead beech leaves amongst which the boughs were lying were found *Craterium minutum*, *Didymium nigripes* and *Lamproderma scintillans*. A large growth of *Craterium leucocephalum* occurred on dead oak leaves, and several gatherings of *Tubifera ferruginosa* were obtained in the rosy immature stage on old stumps.

On September 24th the party was conveyed by motor cars to explore three woods in the neighbourhood of Grindleford. In Highlow Wood the trees consisted of alder, birch, poplar, sycamore, larch and a little Scots fir; the moist peaty ground beneath was trenched with old draining ditches and rough with tussocks of *Aira caespitosa*. Thirteen species of Mycetozoa were found here, of which the most noteworthy were *Enteridium olivaceum*, forming small aethalia on dead sticks, a compact hemispherical aethalium of *Reticularia Lycoperdon* without any

enveloping cortex and showing distinctly the outlines of the component sporangia, and *Perichaena corticalis* abundant on the under surface of dead birch boughs lying among wet grass.

In Padley Wood, our lunching place, oaks clothed the steep sides of a ravine down which a stream fell in small cascades between fern-clad banks. Four species of Mycetozoa were found here, all on fallen boughs of oak: they were, *Comatricha nigra*, a minute form, *Arcyria nutans*, *A. pomiformis* and *Licea pusilla*; the sporangia of the last named species were, as usual, small and inconspicuous, matching in colour the dark decorticated wood on which they had developed. The spores proved to be unusually small, measuring 12 to 16$\mu$, instead of 16 to 20$\mu$, but were typical in colour and marking, being olive grey and very minutely warted all over. Stoke Wood formed a narrow strip beside the river Derwent, and consisted of sycamore and poplar with an undergrowth of dog's mercury, elder and rhododendrons. Of the three species found here the most striking was *Comatricha nigra* var. *alta* which formed conspicuous reddish brown patches extending over an area of six by twenty-four inches on the side of an old fencing plank: most of the sporangia were cylindrical on long slender stalks, but among them were globose sporangia with shorter stalks; the capillitium in all consisted of a tangle of sparingly branched flexuose threads attached chiefly to the base of the columella.

On September 25th we visited the timber yard and explored the woods and gardens of Chatsworth. Seventeen species were obtained, of which ten were found in the timber yard. Here *Fuligo septica* was very abundant on old pine trunks, and also *Arcyria nutans*. *Physarum psittacinum* and *Stemonitis ferruginea* were also found on these logs, in good condition; both are new records for Derbyshire. The fine old oaks, survivors of the giants of Sherwood Forest, scattered over grassy and bracken-covered slopes, yielded two interesting Mycetozoa, viz. *Cribraria rufa*, a species rarely found on any but coniferous wood, and a form of *Liceopsis lobata* having some sporangia stalked, globose and free, and others sessile and closely clustered.

Rough slopes of peaty soil above the Chatsworth gardens, clothed with cushion-like growths of the moss *Campylopus pyriformis*, recalled similar habitats in Epping Forest where *Colloderma oculatum* had repeatedly been obtained. No trace of this species was found at the time, but lumps of the mossy soil were brought away and kept moist; after a fortnight a sporangium of *Colloderma* made its appearance and was soon followed by others until after two months over thirty sporangia had developed.

A visit to the sawpits in the Chatsworth grounds on October 26th resulted in several additions to our list, among them being *Lindbladia effusa* found on sawdust, a species rare in England but obtained in the same locality during the visit of our society to Baslow in May, 1915.

On September 27th the woods called "New Piece" in the Chatsworth grounds were explored, when the most interesting finds were *Hemitrichia clavata*, and the conspicuous red sporangia of *Arcyria Oerstedtii*.

Two of our members visited later Calton Wood, on the Bakewell Road. Here, amongst other species, a small *Comatricha* was obtained on dead wood, agreeing on the whole with *C. elegans* in having the columella divided above to form the primary branches of the capillitium. Some of the sporangia however resemble *C. nigra* in having the columella unbranched and tapering upwards. The two species are undoubtedly very closely allied. Another interesting specimen was obtained by Mr Rea in Cheedale. He found there on a plant of *Mimulus Langsdorfii* growing in the river Wye a perfect development of *Physarum didermoides* var. *lividum*; this well-marked variety had only been recorded before with certainty from the counties of Bedfordshire, Buckinghamshire and Sussex, and always on old straw. In the present gathering we have a new record for Derbyshire and a new habitat for the species. As the plant to which the sporangia were attached was completely surrounded by running water we must infer that the plasmodium had been living under water before it crept up the Mimulus stalk to fruit. It is well known that a plasmodium can in special cases become adapted to submerged conditions, and may even thrive there, but such instances have rarely been met with in the field.

During the two previous forays at Baslow in September 1901 and May 1915, forty-four species of Mycetozoa were obtained altogether; during our recent foray forty-five species were collected, fifteen of which do not appear in the previous lists and appear to be new records for Derbyshire; they are distinguished by an asterisk in the following list.

*B.* refers to Baslow Woods, *C.* to Chatsworth, *Ca.* to Calton Wood, *G.* to Grindleford, *H.* to Highlow Wood, *P.* to Padley Wood, *S.* to Stoke Wood.

*Ceratiomyxa fruticulosa* (Müll.) Macbr., *B.*
*Physarum nutans* Pers., *B.*, *C.*, *H.*, subsp. *leucocephalum* Lister, *B.*
*P. viride* (Bull.) Pers., *H.*, *Ca.*
**P. psittacinum* Ditmar., *C.*

**P. didermoides* (Ach.) Rost., var. *lividum* Lister, *Cheedale.*
*Fuligo septica* (L.) Gmel., *B., C.*
*Craterium minutum* (Leers) Fries., *B., S.*
*C. leucocephalum* Ditmar., *B.*
*Didymium nigripes* Fries., *B., C.*
**D. melanospermum* (Pers.) Macbr., *B.*
*D. squamulosum* (A. & S.) Fries., *B., C.*
*Mucilago spongiosa* (Leyss.) Morg., *B.*
**Colloderma oculatum* (Lipp.) G. Lister, *C.*
*Stemonitis fusca* Roth., *B., C.*
**S. herbatica* Peck, *C.*
**S. ferruginea* Ehrenb. *C.*
*Comatricha nigra* (Pers.) Schroet., *B., C., G., H., P.*, var. *alta* Lister, *S.*
**C. elegans* (Rac.) Lister, *Ca.*
**C. typhoides* (Bull.) Rost., *C.*
*Lamproderma scintillans* (Berk. & Br.) Morg., *B., C.*
*Lindbladia effusa* (Ehrenb.) Rost., *C.*
*Cribraria argillacea* Pers., *B., Ca.*
*C. rufa* (Roth.) Rost., *C., G.*
*C. vulgaris* Schrad., *C.*
**Licea pusilla* Schrad., *P.*
*Tubifera ferruginosa* Gmel., *B., H.*
*Enteridium olivaceum* (Ehrenb.) Rost., *H.*
*Reticularia Lycoperdon* Bull., *C., H.*
**Liceopsis lobata* (Lister) Torr., *C.*
*Lycogala epidendrum* (L.) Fries., *H.*
**Trichia verrucosa* Berk., *G.*
*T. affinis* de Bary, *C.*
*T. persimilis* Karst., *B.*
*T. varia* Pers., *B., C., G., H.*
*T. decipiens* (Pers.) Macbr., *S.*
*T. Botrytis* Pers., *C., H.*
**Hemitrichia clavata* (Pers.) Rost., *C.*
*Arcyria cinerea* (Bull.) Pers., *H.*
**A. pomiformis* (Leers) Rost., *B., C., G., P.*
*A. denudata* (L.) Wettst., *B., C., H.*
*A. incarnata* Pers., *B., C., Ca.*
*A. nutans* (Bull.) Grev., *C., P.*
**A. Oerstedtii* Rost., *C.*
*Perichaena corticalis* (Batsch) Rost., *G., H.*
**P. depressa* Lib., *G., H.*

During the meeting some of our members exhibited interesting specimens which they had recently collected. From the Lake district Dr Adams brought a large growth of *Badhamia rubigi-*

*nosa* (Chev.) Rost. var. *globosa* Lister, on moss, a form of *Physarum globuliferum* (Bull.) Pers. showing in its pale drab tint an approach to the nearly allied *P. murinum* Lister, *Comatricha laxa* Rost., *Lachnobolus congestus* (Somm.) Lister and *Margarita metallica* (Berk. & Br.) Lister. Mr Knight exhibited a fine development of *Badhamia lilacina* (Fr.) Rost. found in the plasmodium stage on Sphagnum in a bog in North Wales.

## LICHENS OF THE BASLOW FORAY.

*By A. Lorrain Smith, F.L.S.*

The members of the Mycological Society naturally place fungi in the first rank for collection, and districts are chosen for the annual foray in which the fields and woods are likely to yield good gatherings of these fleeting plants: lichens have therefore not been considered in the choice of locality. They flourish only in pure air, and at Selby, in the 1918 foray, their absence was very striking, and was due to the smoke-clouds from manufacturing towns near-by. Better times for lichenologists were expected from Derbyshire, but Baslow lay within the influence of Sheffield smoke and lichens again were scarce. The atmosphere seemed to be absolutely pure, but the presence of sooty impurities was amply manifested by the condition of one's hands after a few hours' collecting.

The first day's excursion, in the immediate neighbourhood of Baslow, yielded the best results. On the stone walls by the road-side, there were numerous specimens of *Placodium flavescens* and allied yellow forms. *Lecanora muralis* and *L. parella* were also found; many of the stones were coated with an undeveloped powdery white thallus. *Cetraria glauca* was curiously abundant on some of the scattered boulders. Higher up on the moor, *Sphaerophorus globosus* was collected, with various poorly developed *Cladoniae* and, on the bare soil, *Lecidea granulosa* and *L. uliginosa*. Chatsworth Park proved especially disappointing, as the trees, which in more favourable conditions would have been covered with lichen growths, were quite bare. *Lecidea fuliginea* was noted on dead timber. Other species collected and determined during the expedition were *Lecanora varia*, *Parmelia perlata*, with var. *ciliata*, *P. omphalodes*, *P. physodes*, *Cetraria aculeata*, *Cladonia coccifera*, *C. fimbriata* and *Baeomyces rufus*.

# PLANT SANITATION IN FRUIT PLANTATIONS*.

*By F. T. Brooks, M.A.*
(University Lecturer in Botany, Cambridge.)

The ideal variety of apple or plum for growth on a commercial scale is one which crops heavily and regularly, is of good quality, and is resistant to disease. Unfortunately it is as rare in the case of fruit trees as in other cultivated plants, for all these desirable qualities to be combined together. Many of the best market varieties of apples and plums are subject to serious attacks of fungoid or insect pests, and it often happens that the most valuable commercial varieties are those which suffer most from disease. Indeed, certain diseases, e.g. canker in apples and silver-leaf in plums, may threaten the very extinction of some varieties grown on a large scale, unless measures are taken to control their ravages. Hence fruit growers must of necessity spend considerable time and money in combating disease unless they are prepared to see their plantations become derelict. Whenever a crop is grown on a large scale and is forced to its best efforts towards productivity, disease will frequently tend to increase beyond the normal unless drastic measures are taken to deal with it on its first appearance. If neglected, disease becomes cumulative and in its latest stages often assumes the character of an epidemic even though the particular malady is not one of an essentially epidemic nature.

Plant diseases, like human ailments, can be dealt with in various ways. The best means of dealing with disease, if one may so put it, is to avoid it altogether. With cultivated plants, this desirable end can usually only be achieved by obtaining varieties which are immune or very resistant to the most serious pests, whether insect or fungoid. Thus in apples, 'Bramley's Seedling' is very resistant to canker, and in plums 'Pershore' is almost entirely immune from silver-leaf. With certain human diseases, e.g. small-pox, an artificial immunity can be conferred by vaccination, but similar methods of establishing immunity in plants cannot yet be applied, chiefly because there is nothing comparable in plants to the blood stream in man with all its latent healing properties circulating rapidly through the body.

* A paper read at the Eastern Counties Fruit Growers Conference, November 1919.

It often happens that varieties of cultivated plants which are specially resistant to disease are poor in quality or in cropping power. The plant pathologist and the cultivator here look for the assistance of the expert plant breeder to make the necessary desirable combinations. As is well known, this has already been done with many annual plants, especially the cereals, with great success, and one looks forward to the time when similar developments will take place with perennial plants such as fruit trees, although success in this direction will necessarily be slower. Again, it does not follow that because a plant is immune from one disease that it escapes attack from other diseases. Thus, Lord Derby apples which are resistant to ordinary canker are liable to serious damage by blossom-wilt, and Pershore plums which are practically immune from silver-leaf are often attacked by the fungus *Fomes pomaceus*—which, however, is fortunately far less destructive than *Stereum purpureum*. It is, therefore, a counsel of perfection to advocate the selection of varieties which are not affected by disease, and so means have to be devised and set in operation for attacking fungoid and insect pests as they appear.

In human illnesses, medical means are often applied to effect a cure. Thus some drug is taken, or injected into the blood, which either exerts a stimulative action enabling the body to throw off the malady, or which, by some directly poisonous effect, kills the parasitic organisms that are the cause of the disease. In plant pathology, however, medical treatment by internal application can only rarely be applied with any hope of success, chiefly, as already stated, because the higher plants possess nothing comparable to the blood stream of animals, the movements of sap in the former being essentially different from the latter. There is, however, a mode of dealing with certain insect and fungoid pests which is of the greatest importance to fruit-growers, and which can be compared in some respects to medical treatment. I refer to spraying with insecticides and fungicides —in the use of which fruit-growers, from the time when the vine-growers of France first began to use copper compounds as a means of protection, have always been the pioneers. As is well known, insecticides are usually most potent when applied just as the pest is emerging from the resting state or at any rate before the insect is abundant in an active condition, but many fungicides must be applied before the appearance of the fungus in an infectious form in order for the leaves and stems to be protected from penetration. Certain pests and diseases, such as aphis in plums and scab in apples, can be entirely, or almost entirely, controlled by spraying. It is not proposed to deal further with the subject of spraying in the present paper, except

to say in passing that much money is sometimes wasted by spraying at the wrong time.

Finally, there are the surgical and hygienic means of dealing with plant diseases. At a time when hygienic measures are assuming increasing importance in the medical profession, it is of interest to point out that these twin phases of plant sanitation have long been the mainstay of the plant pathologist, and probably will long continue to be. Fruit trees in particular lend themselves to surgical treatment when attacked by certain diseases. It is not the case here that if one member of the plant body suffers, all the other members suffer with it, for the unruly limb of a fruit tree can be severed with nothing but benefit accruing to the remainder of the tree. Fire is the strongest weapon in the armoury of the plant pathologist, and notwithstanding that its frequent use in this connection is sometimes slightingly referred to as a primitive and unscientific weapon, and not at all in keeping with the elaboration of the twentieth century, it is undoubtedly the surest destroyer of disease that exists. In plant sanitation, one aims at the eradication of the sources of infection. This is a point of view which should be kept constantly in mind by the cultivator. It may be urged that it is impossible to eradicate completely the sources of infection in the case of the commonest plant diseases. Be that as it may, and certain human diseases such as yellow fever have been wiped out in parts of the tropics solely by the application of sanitary measures, conviction is firm that many of the most serious fungoid pests can be greatly reduced by destroying their breeding grounds which are still often left either within or near fruit plantations. It is a well known fact in medical science that in diseases of parasitic origin like malaria and tuberculosis the magnitude of the dose, so to speak, of the parasite frequently determines whether disease is established or not. If only a few germs are absorbed, the parasite may not be able to establish itself, while if many are taken in, disease will develop rapidly. The same factor operates with certain plant diseases, and many growers here must be familiar with plum orchards which, through neglect in the eradication of branches bearing *Stereum purpureum*—the cause of silver-leaf disease, succumbed in the later stages with amazing rapidity. In such cases, probably the most potent factor is the great abundance of spores shed by the fungus in the immediate vicinity.

The first principle of sanitation in fruit gardens is to avoid as completely as possible any harbourage for the breeding of insect and fungoid pests. This postulates the cutting off of branches which are dying back and their speedy destruction on the spot by fire, or removal from the plantation. If the severed

branches are allowed to remain in the plantation, the fungus which killed them will soon fructify and shed its spores around in the same way as if still attached to the standing tree. Large wood piles are often seen in fruit plantations forming excellent breeding grounds for such a destructive pest as *Stereum purpureum*. In these days of fuel shortage there should be no difficulty in disposing of wood cut out in this way. Not long ago I saw a gigantic pile of red currant prunings in the midst of a large area of red currants, the prunings being literally smothered with the pink fructifications of *Nectria cinnabarina*, which, as many fruit growers know to their cost, is becoming increasingly destructive to red currants. There is no reason why these prunings should not have been burnt as soon as collected. In cutting out diseased branches, action must be sufficiently drastic to ensure that the downward limit reached by the fungus is excised. This is particularly important with silver-leaf disease, the region penetrated by the fungus being marked by a brown discolouration in the wood, which is often a considerable distance below the silvered foliage. In this connection mention may be made of a case seen during the summer: the branches of certain silvered 'Lord Grosvenor' apple trees had been cut back, but not far enough, as the fungus *Stereum purpureum* was developing in quantity from each of the exposed extremities. We have not infrequently seen silvered trees the upper parts of which have been lopped and the trunks left standing and bearing enormous quantities of *Stereum*. Such a practice cannot be too strongly condemned. Where large branches are severed, the exposed surfaces should be made smooth and covered with tar to prevent the ingress of wound parasites. While on the subject of branch infection by silver-leaf, it may be mentioned that it is usually the wisest economy to cut out silvered branches as they appear, i.e. before they die back; there is then not the slightest opportunity of the fungus fructifying through delay in cutting out the dead wood.

With other diseases there is often no means of telling that a parasite has entered the tree until the branches begin to die back and fructifications of the fungus appear. This is particularly the case with the die-back of plums and cherries caused by the fungus *Cytospora leucostoma* and the affection of plums due to *Fomes pomaceus*. In such, drastic action can only be taken upon the appearance of the first external signs of disease, when the greater part of the trees can often be saved, if excision is effected judiciously. While dealing with the subject of excision, it is recommended that, in soft-wooded varieties such as the 'Victoria' plum, the branches of which frequently break through overcropping, broken limbs should be cut back flush

with a larger branch or main stem immediately after removal of the fruit. It is the ugly wounds of broken branches which offer special facilities for the entrance of wound parasites such as *Stereum purpureum*.

Where a tree is dying back to such an extent that its loss is inevitable, it is important that the stump should be removed if possible at the time of felling. Unlike the forester, the fruit-grower is little troubled by the action of root parasites, but nevertheless the stumps and the larger roots should be removed in order to prevent the growth of suckers and for the future convenient working of the plantation. If the stump cannot be removed, it should be covered with soil to prevent the development of dangerous fungi such as *Stereum*. In the case of plum trees removed on account of silver-leaf disease one has always hitherto hesitated to suggest the planting of other susceptible varieties of plum on the same site, but during the past summer considerable areas have been seen in which young 'Victoria' plums have been planted where older silvered trees have been removed; these young trees have remained healthy up to the present, i.e. for a period of 2 or 3 years. Although one is not in a position at present definitely to recommend this course, there seems to be no undue risk in replanting with the same variety, if this is desirable for other reasons, and provided the stumps of the diseased trees are removed.

As time proceeds, greater care will probably be devoted to the control of such diseases as brown rot of apples and plums which in certain seasons levy a heavy toll on the fruit. In the main, this trouble is carried over from season to season by fruits which, mummified by the action of the fungus, hang upon the trees during the winter or lie on the ground. Where brown rot is liable to be severe, it would be worth while to have these mummified fruits collected and destroyed during the winter. Another closely allied disease, the blossom-wilt which Wormald has shown severely affects 'Lord Derby' apples, can be dealt with by the excision of the affected spurs. It has been demonstrated that this operation of removing the diseased spurs is commercially profitable. Again, the common scab fungus, *Fusicladium dendriticum*, usually hibernates in the young twigs of the most susceptible varieties of apples, and while pruning is being done, care should be taken that all the twigs which show small pustules in the bark should be cut off. With the common canker caused by *Nectria ditissima* it is generally recognised that this disease is chiefly dependent upon the nature of the variety and the conditions of the soil. There is evidence too that the influence of the stock is not inconsiderable in this connection. The wise fruit-grower will therefore select his varieties accordingly.

Excision of cankered areas is undoubtedly profitable in some cases, particularly in young trees, as this trouble, like most others, becomes cumulative if neglected.

Care must be taken to prevent the development of dangerous fungi not only within the plantation but also in its immediate vicinity. On more than one occasion I have seen silvered sloe trees with the fungus *Stereum purpureum* developing on the dying branches, in hedges bordering plum plantations. It is obvious that such trees should be removed, as well as any other, such as laburnum, which happen to develop silver-leaf disease. The stumps of elm trees in hedgerows are a prolific source of the same species of *Stereum* and it is known that the fungus from this source is just as dangerous in causing silver-leaf as is *Stereum* taken from a dying 'Victoria' plum. Stumps of practically all broad-leaved trees with the exception of oak are liable to give rise to profuse growths of this fungus. Such stumps should be eradicated, charred, or covered with soil if they are on the borders of fruit plantations. Fruit gardens situated in the midst of agricultural land are more favourably placed as regards danger of attack by wound parasites than are plantations near woods, in which most of these fungi find an excellent harbourage. There is no excuse, however, for such a practice as that of making fences of plum wood around fruit plantations. That is simply asking for trouble. I once saw a fence, made of plum wood, separating one plum plantation from another, which was literally covered with the fructification of *Stereum purpureum*. Can it be wondered at that silver-leaf disease was rife in both these gardens? In another place, a number of half-standard plums were tied up to stakes made of birch stems on which *Stereum* was developing in abundance.

With a few diseases such as plum rust and black currant rust, the fungus completes its life on two different kinds of plants. Thus in the plum rust, the fungus lives indefinitely in the perennial parts of the commonly cultivated Anemone, *Anemone coronaria*, in the leaves of which spores are produced in the spring, which in turn affect plum leaves. Unless, therefore, the diseased anemones are eradicated, there is no means of preventing attacks of plum rust in the immediate vicinity. Some years ago, I saw a very severe attack of plum rust in fruit orchards near a florist's garden in which diseased anemones were known to be present. So severe was the plum rust that the trees were defoliated by the end of August. More recently, the florist's garden has been converted to other purposes and plum rust has been scarcely noticeable in the vicinity. One is strongly inclined to suggest cause and effect as operating here. With black currant rust, in which the effect of a bad attack is

less noticeable, the alternate stage of the fungus grows upon Weymouth pines, which it gravely injures. Here again diseased Weymouth pines should not be allowed to occur in the neighbourhood of fruit gardens. If a comprehensive system of inspection of plant diseases is ever instituted in this country, these are two of the diseases which will have to be kept under observation, for although they are not at present a menace to the fruit-grower, they have dangerous potentialities.

The remarks just made with reference to market plantations apply with even more force to nursery gardens. The nursery is the foundation of all sound fruit growing, and this country is fortunate in possessing many firms of nurserymen who have the highest possible sense of responsibility to their customers. If one imagines what might have been distributed by way of disease and by poor quality stocks by untrustworthy people, the effective manner in which the nurseries have firmly established the market fruit-growing industry in this country will be at once recognised. Nurserymen should deal even more drastically with disease than the market grower. If silver-leaf happens to appear, the affected plants should be immediately burnt. It must be recognised that some of the operations carried out in the nursery necessarily entail a risk of infection by wound parasites. Thus in budding and grafting, the exposed tissues may be penetrated by *Stereum purpureum* with the result that silver-leaf disease develops. It is sometimes the practice in budding young nursery stuff to leave a long stub belonging to the stock, to which the developing bud can be tied, thus obviating the necessity of staking. While this practice is almost entirely innocuous with apples, it is fraught with some danger to plums and peaches, especially if these are worked on the 'Brompton' stock which, it is well known, is very susceptible to silver-leaf. It would probably be a sounder practice to cut back the stub, cover the exposed end with grafting wax or with an antiseptic, and tie the developing bud to a stake. That great care is taken generally by nurserymen in eradicating silver-leaf if it happens to appear in the nursery, is evidenced by the fact that it is very rare to see silvering in plum trees under 5 years of age.

Persons who only occasionally grow stocks and work them may perhaps take less care in avoiding disease than the regular nurseryman. Statements have been made that silvered suckers are sometimes taken from diseased plum plantations to be used as stocks, and although reputable nurserymen would not countenance such a practice, provision should certainly be made to prevent the possibility of silvered suckers being used as stocks. If any wide system of nursery inspection is contemplated

in the future, care must be taken, in fairness to the established firms, that those persons who grow stocks for a year or two spasmodically are also subject to its provisions.

There remains to be discussed the best time for carrying out these operations. Whenever a disease is seen, the motto "Do it now" applies with great force to whatever measures may be contemplated. If labour conditions permit, the best time for action on the above lines is during the summer when there is a clear differentiation between healthy and diseased branches. Furthermore, the wounds made by severing branches then have a chance of partly healing before the winter. Action during the early summer is specially important in dealing with silver-leaf, because it is well known that the fructifications of *Stereum purpureum* are produced in greatest abundance on the dead wood during the latter part of the summer and autumn. While pruning and thinning out are taking place during the winter a second opportunity is afforded of dealing with some of the pests which have been briefly mentioned. If, however, labour conditions do not permit of cutting out dead wood during the summer, excision must be left until the autumn and winter.

In large areas of fruit there is a great deal to be said for placing the operations of plant sanitation, spraying, and pruning in the hands of an expert with a gang of men under him. The expert is often anathema to the practical man, but the time seems to have come in large market fruit-gardens, when there is a great deal to be said in favour of a division of labour, the respective portions of the work being in charge of men of special training. In districts where small fruit plantations are the rule, much might be done in the same way by co-operative effort. In the case of the rubber plantations of the East—of which I happen to have some knowledge—there is upon every estate of importance what is known as a pest gang whose sole duty is to watch for and treat disease as soon as it appears. This pest gang is either officered or supervised by a European under whom are one or more intelligent natives who direct the coolies as to what is to be done. In the tropics, sanitary measures of the same kind as those outlined above, are considered of the greatest possible importance, and one of the chief anxieties of the managers of these estates is in seeing that the pest gang is adequately doing its work. Of course most of these rubber estates are much larger than fruit gardens in this country—many of them exceed 1000 acres, but so important is the question of combating disease now considered to be, that some of the largest estates employ a fully trained plant pathologist in an advisory capacity, in addition to the Government staff which is always available. As stated above, there is much

reason in the fruit-growing industry for placing spraying, pruning, and sanitary measures in the hands of a separate labour unit controlled by a man with special knowledge.

Although particular stress has been laid upon certain sanitary measures in controlling some of the diseases that attack fruit plantations, other measures such as winter washing, and grease banding, are of equal importance in diminishing the activities of certain pests, but these subjects have often been dealt with and there is no time for their consideration now. Of primary importance too in the well-being of fruit gardens are adequate drainage, sufficiently wide spacing of the trees to allow of the free circulation of light and air, and reasonably good cultivation of the soil. On the last topic one word may be ventured. It is known that rapidly acting nitrogenous manures induce a succulent type of growth which readily falls a prey to fungoid disease, while on the other hand slow-acting manures such as basic slag and shoddy tend to promote growth in the trees, which rapidly ripens and is less susceptible to parasitic attack.

It may be asked whether the sanitary measures dealt with in this paper are economically sound. The universal test of every commercial operation is the question whether it pays or not. It may be urged that in the long run greater profits will be made where diseases are allowed to run their course in view of the cost of the operations briefly described in this paper. But he would be a bold man to-day who ventured to assert this, and all who have seen plantations of 'Victoria' plums rendered completely derelict by neglect of silver-leaf disease will agree in stating that sanitary measures in fruit gardens are worth while and serve as the best means of insurance for the future. Progressive fruit-growers have long recognised this, but their efforts towards cleanliness in their plantations are sometimes partly discounted by apathy on the part of their neighbours. Those growers, for instance, who neglect silver-leaf disease are a menace not only to themselves, but to their fellow cultivators. The time has come when a person who allows trees killed by silver-leaf disease to remain standing and be the means of propagating the insidious fungus which causes it, will be looked upon as committing a nuisance for which there must be pains and penalties. Public opinion amongst fruit growers, however, can do more good towards introducing proper treatment for the troubles occasioned by disease than all the legislation in the world. It is a pleasure to note that a healthy public opinion in this respect is rapidly developing amongst fruit growers.

With silver-leaf disease, measures of plant sanitation can alone be used at present as a means of control. These measures are simple and easy to carry out, and I am convinced after much

experience of the disease and its treatment, that the disease can be effectively controlled in this way. Silver-leaf and similar troubles are sometimes looked upon as "Acts of God" for which there is no treatment, or else alarm is raised and some nostrum is requested in a hurry which will cause recovery in trees that are already doomed and dying. The cry has been raised that the cultivation of the valuable 'Victoria' plum will be wiped out by the spread of silver-leaf disease. Nothing of the kind—that is, if the measures advocated in this paper are effectively pursued. Where plantations of 'Victoria' plums have been killed by this disease, there has always been terrible neglect, but one hopes that such gardens will soon cease to exist in all the important fruit-growing districts of the country.

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## A DRAIN-BLOCKING FUNGUS.

*By A. Lorrain Smith, F.L.S.*

In September 1919, material was submitted to me that had been taken out of a sewer in the City of London 30 feet below ground, and under the vaults of a bank previously the site of Crosbie Hall. The whole mass weighed about ½ cwt. and had completely closed the drain-pipe. The substance was sodden with water and of a uniform brownish-yellow, but there was no difficulty in recognising its fungus nature and that it was a *Fomes*. As the fungus dried, layers of white pileus and long cinnamon-coloured tubes became visible. The specimen was exhibited a few days later to the members of the Mycological Society at their annual meeting at Baslow, and Mr Carleton Rea unhesitatingly pronounced it to be *Fomes ulmarius*, a fungus which has always been considered to grow on elms.

There is at the present date no living elm in the neighbourhood of Crosbie Square. Search was made, while tunnelling to remove the obstruction, for any material on which the fungus could have originated; the gap in the pipes was found by which the fungus had penetrated into the pipe; and near to this lay a piece of timber of coniferous wood. The wood was fairly rotten and the cells occupied by mycelium, but there was no sufficient evidence that the fungus had any connection with this wood. Mr Rea tells me that elm roots travel long distances and he has had experience of drains being blocked by the roots of an elm tree

50 or 60 yards away. It may be that remains of elm roots or timber are present in the soil. It might also be possible that the fungus had lived on the coniferous wood. The *Fomes* was found in four different places; it has now been removed at great cost and trouble.

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## STUDIES IN DISCOMYCETES II.

*By Jessie S. Bayliss Elliott, D.Sc. (Birm.), B.Sc. (Lond).*

5. *Dasyscypha conformis* (Cooke) Sacc.

During the last two years I have often found on the dead stems of rushes *Erinella apala* (B. & Br.) Sacc. growing very plentifully and also *Dasyscypha conformis* (Cooke) Sacc.; sometimes both were growing together on the same clump of rushes. Massee (British Fungi, Vol. iv. p. 334) states that the latter species was unknown to him and also that he was unable to find the type specimen in Cooke's herbarium. Both Discomycetes are very similar except in microscopic characters, but after meeting the two frequently, one recognises readily with a hand lens *D. conformis* by its larger size and its sessile or very shortly stipitate form (fig. 3). It has been suggested that *D. conformis* might be an immature form of *E. apala*: but after studying both species I find the microscopic characters of the two very distinct.

Since Cooke's description of *D. conformis* copied by Massee is very incomplete and also has inaccurate spore measurements, I think it would be useful to describe the fungus again.

*D. conformis*. Gregarious or scattered, sessile or very shortly stipitate, ·75–1 mm. diameter, cupulate becoming plane, fawn colour, covered with short, wide, colourless, obtuse, clavate, aseptate hairs filled with oil drops when fresh; excipulum parenchymatous, cells oblong; asci subcylindrical, 65–70 × 7$\mu$, apex obtuse, spores slenderly lanceolate 14–20 × 1·5$\mu$, one or two seriate, straight, sometimes slightly curved; paraphyses acerose, exceeding the asci, some narrow, others wide—5$\mu$, filled with oil drops when fresh (figs. 3, 4, 5, 6).

*E. apala* is distinguished from the above by the much longer spores arranged in a fascicle, the septate paraphyses which project further above the asci than do those of *D. conformis*, and also by the long narrow tapering hairs which surround the margin and cover the excipulum, and which form a sharp contrast to the obtuse clavate marginal hairs of *D. conformis* (figs. 7, 8.)

6. *Orbilia leucostigma* Fr., v. *xanthostigma* (Fr.) Rehm.

I have found this fungus very frequently growing luxuriantly and examined many specimens, also I have had it under observation while growing for many months. The form of the spores is described as elliptical or egg-shaped by Massee, Rehm and Saccardo; this description is misleading and incomplete since they are decidedly U-shaped: when the two ends of the U are in view the spores appear as two circles (o o) and only when the curved top of the U is in focus can they be called elliptical (figs. 9, 10). In Boudier's Icones they are figured as U-shaped.

This fungus seems to me identical with *O. coccinella* (Somm.) Fr. the spores of which are said to be slightly wider, being given as $3–4 \times 2\mu$, thus having only a trifling difference from $3–4 \times 1{\cdot}5\mu$ (Massee) or $3–4 \times 2–3\mu$ (Boudier), the measurements of *O. leucostigma* v. *xanthostigma*; also the colour distinction is insignificant. *O. coccinella* is described as blood red or deep orange red while *O. leucostigma* v. *xanthostigma* is said to be yellow with sometimes a tinge of red when fresh. The specimens which I find usually vary from yellow to deep orange and often there is a sprinkling of whitish translucent forms among them while, when dry, a blood red colouration is usual, but this varies and is sometimes yellow; I have seen them just as blood red as those figured by Boudier as *O. coccinella*.

Although Boudier figures spores of *O. coccinella* as ellipsoid, in Engler and Prantl two figures of the spores are given, the one (profile view) showing a very curved, almost a U form, the other elliptical; thus all characters considered there is no real distinction between *O. leucostigma* v. *xanthostigma* and *O. coccinella*.

7. *Pyrenopeziza plicata* Rehm ( = *Mollisia plicata* (Rehm) Sacc. sec. Boud.) f. *conicola*.

Ascophores scattered and crowded, $\frac{1}{2}–\frac{3}{4}$ mm. diameter, sessile, or when young very shortly stalked, closed and almost globose at first, becoming saucer-shaped or even repand when old; disc greyish, margin whitish, fimbriate, hairs septate and obtuse; excipulum olive brown or blackish, parenchymatous, rough with rounded hair-like outgrowths from the cortical cells, often more or less vertically wrinkled; asci cylindrical, apex somewhat narrowed, $80 \times 6\mu$; spores oblong, fusiform, hyaline, continuous, straight, or slightly curved; two seriate; $10–12\mu \times 2\mu$; paraphyses slender, hyaline, equal, $2\mu$ wide and same length as the asci (figs. 11, 14, 15, 17).

The apothecium is often attached to the substratum by a fringe of colourless hyphae (fig. 11*a*).

*Habitat.* Cones of *Pinus sylvestris*. Tanworth-in-Arden.

This is closely allied to *P. Mercurialis* (Fuck.) Boud., and also to *Mollisia atrata* (Pers.) Karst., with its numerous varieties, and allied species whose habitats are herbaceous stems.

Growing on the same cone in close relation with this Discomycete were crowds of small black pycnidia belonging to the genus Phoma and on the older specimens of these the young apothecia of the Discomycete could be seen, growing either out of the top or the sides (fig. 11); the inference seems justifiable that these pycnidia are the conidial stages of the Discomycete; the external appearance of the pycnidia even in microscopic detail resembles that of the Discomycete.

The pycnidia are erumpent and in many instances a scar similar to the one seen in connection with the pycnidium was also to be seen below the apothecium (fig. 11).

PHOMA CONICOLA. Pycnidia erumpent, gregarious or scattered spherical, ·2 mm. diameter, sessile, olive brown or black, excipulum parenchymatous, rough with round hair-like outgrowths from the cortical cells, similar to the excipulum of *Pyrenopeziza plicata* Rehm f. *conicola*, at first closed, then open, margin fringed with septate colourless hairs which converge: pycnospores colourless, oblong 3 × 1–1·5$\mu$, some slightly bent, continuous, situated on short conidiophores, arising from the walls of the pycnidium (fig. 11*b*, 12, 13, 16, 18).

*Habitat.* Fallen cones of *Pinus sylvestris*. Tanworth-in-Arden.

Under very moist conditions the pycnospores ooze out and form a glistening white ball on the top of the pycnidium: this elongates, topples over and the pycnospores are dispersed in the surrounding moisture: they germinate within twenty-four hours in rain-water (fig. 18).

The pycnidia need far moister conditions for development than the apothecia, and by varying the humidity of the moist chamber containing a cone on which both of these forms were growing, either the one or the other prevailed.

*Pyrenopeziza plicata* Rehm has previously been found in Britain, but apparently not recorded. I have seen specimens from the herbarium of W. B. Grove collected by him at the Edge Hills on dead *Angelica* stems, 1884, and by C. B. Plowright collected at Kings Lynn on some dead herbaceous stems in 1873.

PHOMA CONICOLA n. sp.

Pycnidia gregaria vel sparsa, erumpentia, sphærica, 0·2 mm. diam., sessilia, olivaceo-brunnea vel nigrescentia, excipulo parenchymatico, vesiculis e cellulis extimis oriundis obsito, ei Pyrenopezizæ simillimo, primo clausa, dein aperta, margine pilis achrois septatis convergentibus fimbriato. Sporulæ

achroæ, oblongæ, 3 × 1–1·5μ, interdum curvulæ, continuæ, sporophoris brevibus suffultæ.

8. *Hyalinia Leightoni* (Phill.) Boud. v. *lignicola.*

Scattered or crowded, confluent, sessile, glabrous, diaphanous, translucent, depressed or almost plane 1 to 1·5 mm. diameter; when dry angularly contracted with margin sometimes raised; hymenium whitish, excipulum parenchymatous and fuscous: asci cylindrical, apex narrowed 100 × 8μ; spores 8–13 × 2·5–3μ, elliptical with blunt ends, irregularly one or two seriate; paraphyses filiform, branched, same length as asci, ·5μ wide (figs. 1, 2, 28, 29, 30).

*Habitat.* Decaying wood. Plowden near Shrewsbury, Sept. 1917.

This fungus seems to differ very little from *Calloria Leightoni* found by Phillips growing on a Polyporus, and which does not appear to have been seen since: it seems advisable however to consider it a variety as the substratum is very different, and the colour fuscous instead of yellow or white.

9. *Calloria extumescens* Karst.

Gregarious or often confluent, ·3 to ·5 mm. diameter, sessile, globose at first becoming plane or slightly concave, glabrous, sub-gelatinous when moist, excipulum formed of anastomosing hyphae, bright yellow when young, becoming flesh coloured or reddish brown; asci cylindrical clavate, 60 × 6μ; spores hyaline continuous or uniseptate (rarely more) 10–13 × 2μ, elliptical, ends rather acute; paraphyses filiform, 1–1·2μ (figs. 23, 24, 25, 26, 27).

*Habitat.* On decaying oak. Bomere near Shrewsbury, Sept. 1917.

This agrees with Karsten's description of *C. extumescens* but according to Rehm the excipulum should be parenchymatous. Karsten does not describe the excipulum.

This fungus is also near *Mollisia Mali* (Rehm) Phill. ( = *Urceolella Mali* (Rehm) Boud.) but differs in the confluent apothecia, the uniseptate spores, which sometimes even have two septa, also the colour which although bright yellow when quite young becomes flesh-coloured and reddish brown later.

10. Mollisia Populi n. sp.

Gregarious, sessile, saucer-shaped, becoming plane and revolute, 1–2 mm. diameter, hymenium grey when young, pinkish or ochraceous when older; excipulum grey with an olive tinge, parenchymatous, margin fimbriate, asci cylindrical, 90–100 × 7–10μ, apex narrowed, short pedicel, spores two

seriate, hyaline, narrowly fusiform, straight or slightly curved, continuous, one septate, 20–25 × 2–3$\mu$; paraphyses containing oily protoplasm in the terminal cell, hyaline, stout, septate, thickened upwards to 7–8$\mu$ wide, apex narrowed length not exceeding the asci.

*Habitat.* On dead twigs and branches of poplar. Tanworth-in-Arden.

This fungus has some points of resemblance with *M. atrata* (Pers.) Karst. v. *eupatoricola* (Phill.), including the large conspicuous paraphyses, but it grows on wood not herbaceous stems, it is a bigger fungus, and its spores are longer varying from 20–25$\mu$, instead of 10–18$\mu$.

It also somewhat resembles *Niptera ramealis* Karst. ( = *Mollisia ramealis* Karst. sec. Boud.), but although the spores are within Karsten's wide limits of 14–30$\mu$, they are not blunt at the ends neither are the paraphyses thread-like, being much wider than the outside limit given (3$\mu$), being as wide as the ascus, 7–8$\mu$.

Rehm considers *N. ramealis* Karst. the same as *Belonidium ventosum* (Karst.) Phill. (*M. ventosa* Karst. sec. Boud.); if that is so, the above fungus differs considerably since it has a parenchymatous excipulum and a fimbriate margin in contrast with the excipulum of interwoven hyphae and smooth margin of *M. ventosa*, also the spores are larger and the paraphyses very different.

This fungus was found in August 1917, growing on branches which had been pruned from a flourishing young poplar tree less than two months previously, and left lying in a heap on the ground.

MOLLISIA POPULI n. sp.

Gregaria, sessilis, patelliformis, dein plana ac revoluta, 1–2 mm. diameter; hymenium junius cinereum, senius incarnatum vel ochraceum; excipulum olivaceo-cinerascens, parenchymaticum, margine fimbriato. Asci cylindrici, 90–100 × 7–10$\mu$, apice attenuato, pedicello brevi. Sporidia biseriata, hyalina, anguste fusiformia, recta vel leviter curvata, continua, 1-septata, 20–25 × 2–3$\mu$; paraphyses haud ascos superantes, hyalinæ, amplæ, septatæ, superne ad 7–8$\mu$ incrassatæ, apice ipso attenuatæ.

I wish to express my thanks to Mr W. B. Grove, M.A., for useful criticism and help in various ways and also to the late Prof. G. S. West for the loan of books of reference.

## DESCRIPTION OF PLATE VI

Fig.

1. *Hyalinia Leightoni* v. *lignicola*. Asci and paraphyses.
2. Parenchymatous excipulum of *H. Leightoni* v. *lignicola*.
3. *Dasyscypha conformis*. Apothecia.
4. Ascospores.
5. Clavate marginal hairs and parenchymatous excipulum.
6. Aseptate paraphyses containing oil drops and asci.
7. *Erinella apala*. Septate paraphyses and ascus containing a fascicle of ascospores.
8. Tapering marginal hairs incrusted with crystals.
9. *Orbilia leucostigma* v. *xanthostigma*. Ascospore.
10. Asci containing ascospores.

11*a*. *Pyrenopeziza plicata* f. *conicola*. Apothecia.

*b*. Pycnidia of *Phoma conicola*.

The apothecia are to be seen growing among and arising from the pycnidia.

12. Young pycnidium of *Phoma conicola*. The young apothecium of *P. plicata* f. *conicola* is similar in all detail.
13. Pycnospores oozing out of a pycnidium.
14. Asci and paraphyses of *P. plicata* f. *conicola*.
15. Section through young apothecium of *P. plicata* f. *conicola* showing the rounded hair-like growths on the excipulum.
16. Section through young pycnidium of *Phoma conicola*.
17. Apothecia of *P. plicata* f. *conicola* on cone.
18. Pycnidium of *Phoma conicola* with the rounded glistening mass of pycnospores imbedded in mucilage.
19. *Mollisia Populi*. Apothecia.
20. Ascospores of *M. Populi*.
21. Excipulum with fimbriate margin.
22. Paraphyses—narrow and wide varieties; also ascus containing ascospores.
23. *Calloria extumescens*. Confluent apothecia.
24. Excipulum formed of anastomosing hyphae.
25. Apothecia of *C. extumescens*.
26. Asci and paraphyses.
27. Ascospores, continuous and uniseptate.
28. *Hyalinia Leightoni* v. *lignicola*. Apothecia.
29. Apothecia, crowded and confluent.
30. Ascospores.

# ON THE FORMATION OF CONIDIA AND THE GROWTH OF THE STROMA OF DALDINIA CONCENTRICA.

*By Jessie S. Bayliss Elliott, D.Sc (Birm.), B.Sc. (Lond.).*

The curious charcoal-like sporosphore of *Daldinia concentrica* have often attracted the attention of mycologists and several have kept it under observation for more or less lengthy periods and have also cultivated it and noted points of interest in its life history. In 1863 Tulasne* published an excellent description of the ascophore also noting the presence of conidia on it previous to the formation of perithecia. In 1901 Möller† published the results of his observations on the rapidity of growth of the stroma and the duration of spore production. He also germinated ascospores and obtained the conidial condition in his cultures. In 1904 Molliard‡ published a paper describing how he had obtained the conidial form by sowing ascospores on pieces of carrot enclosed in tubes. Again, in 1913, Brooks§ in a paper describing some culture experiments he had carried out refers to finding conidia on blocks of ash which he had infected with ascospores. Descriptions of the ascophore are also given by Rabenhorst‖, Berkeley, Cooke and others.

For more than five years I have had under observation logs of ash on which both the conidial and perithecial forms of this fungus appeared from time to time. The conidial form was to be seen during the spring, summer and autumn months as a cream-coloured incrustation (figs. 35, 36) several sq. centimeters in area both on the bark and on the sawn ends of the logs, chiefly in the damper parts where they touched the ground and in parts shaded by grass: its surface had a coarsely villose appearance (fig. 36) owing to the tendency of the conidiophores to mass together and form small stromata about 3 or 4 mm. high by 1·5 mm. broad (fig. 36). Colourless conidia were produced in great quantities giving the patches a powdery appearance; the

* Tulasne. Selecta fungorum Carpologia, T. II.

† Möller, A. Phycomycetes and Ascomycetes. In Schimper, A. F. W., Bot. Mitth. aus den Tropen, Heft 9. Jena, 1901.

‡ Molliard Marin Forme conidienne de Daldinia concentrica. Bull. Soc. Myc. de France. Tome XX, 1904, pp. 55–60.

§ Brooks. Observations on pure cultures of some Ascomycetes and Basidiomycetes. Trans. British Mycological Society, 1913.

‖ Rabenhorst. Kryptogam. Flora. Band I, Abth. 2.

conidiophores are much branched and since the branches come off in a verticillate manner and terminate in clusters of conidia (figs. 31, 33) the fungus is evidently a species of Botrytis. On one of these conidial areas small hemispherical nodules with a rich brown velvety covering appeared (fig. 36). These on being cut showed the characteristic zoning of *Daldinia concentrica*. One produced ten zones in three weeks and the cut surface examined three weeks later was found to be covered by the conidial form but on being cut again ceased to grow.

Tulasne describes the presence of conidia on the stromata previous to the formation of perithecia; I have examined many specimens while growing and have only come across traces of this except on stroma of exceedingly small diameter, 3 mm. or less; whereas the creamy conidial patches on bark (fig. 35) which appear before or at the same time as the ball-like stromata are quite common on ash logs.

During the Selby foray this year (1918) both at Byram Park and Garforth patches of conidia were very abundant in close proximity to the sporophores, and also quite apart from them, on the ash logs which lay scattered about so plentifully.

Although this conidial form is so common, it is not recognised as belonging to the perithecial stroma, nor does it appear to have been recorded as a Botrytis: as already mentioned several investigators have obtained it by infecting culture media with ascospores, and one, Molliard, recognising its systematic position has proposed to call it *Nodulisporium* (*Botrytis*) *Tulasnei*; but he considered it was unlike any described species, possibly through being grown under artificial cultural conditions.

The conidia are colourless and measure 6·5–8 × 5–6$\mu$.

*Culture experiments.* Large chunks of ash after being sterilised were infected with conidia as were also small chips in tubes;—some of these chunks were placed out in the open, others were kept in the laboratory. In the laboratory a fluffy mycelium appeared on them which although white at first gradually became black; when after eighteen months these chunks were placed out in the open air on grass in the shade, the black mycelium disappeared and the characteristic villose conidial patches appeared; the cultures which from the start were out in the open within three months produced conidia but no black mycelium: the conidial patches always became brown. Large patches 10 sq. cm. or more have appeared every year on these infected blocks but as yet no perithecial stromata have been seen; the blocks are still in a very sound condition unlike the log on which the perithecial sporophores appear which is in an advanced stage of decay.

*The perithecial stroma.* As long as the stroma is growing the

exterior is brown in colour and it only becomes black when it ceases growth; at this stage the whole stroma is exceedingly brittle and carbonaceous especially the exterior layer, about ·5 mm. in thickness, which is so hard that it is difficult to force even a sharp needle through it, but the interior remains quite soft and has a somewhat fibrous texture. The *zoning* so characteristic of this fungus is due to the formation of successive layers of perithecia. Perithecia are continually being formed in the stroma just immediately beneath the thin hard external layer (fig. 36); they are to be seen even in stromata of 3 or 4 mm. diameter but only those of the last formed zone reach maturity; the outlines of previously formed perithecia (fig. 34) are to be observed more or less distinctly in the zones near the exterior; these are easily recognised because the hyphae forming the walls of the perithecia turn black some time before the hyphae which form the bulk of the stroma.

Although actual experiments were not carried out, from various observations there seems reason to believe that the periods of perithecial maturation correspond with periods of diminished humidity while increase in humidity brings about active growth which ultimately leads to the formation of a new perithecial zone and atrophy of the perithecia of the preceding zone.

It is quite recognisable that the fibrous nature of the interior of stromata is due to these perithecia which never attain maturity: some zones in consequence of the perithecia having attained quite an advanced stage of growth before renewed growth of the stroma occurred have quite a porous appearance owing to the numerous large sterile perithecial cavities there.

Although in section mature stromata look a smoky-brown colour, while growing the last four or five zones are seen to be zoned alternately black and white: the black zones owe the dark appearance to the abundant perithecia there, the walls of which are always nearly black (fig. 34).

The hard exterior is exceedingly protective for a stroma becomes immediately mined by slugs when cut, or after being cracked by frost: the stromata crumble away during the winter and so do not last more than one year.

Very young stages in the formation of perithecia are difficult to observe because they are formed close under the dark brittle protective outer layer of the stroma: in the youngest which could be clearly distinguished small spherical masses of hyphae (figs. 38, 39) were seen which consisted of an external covering tissue of densely woven, very narrow, thin walled hyphae, surrounding a central hyphal mass of very wide septate hyphae: the latter formed an irregular coil of several turns and doubtless functioned as ascogenous hyphae: very similar structures are

to be seen in sections of young perithecial stromata of *Xylaria polymorpha*, Ustulina and other fungi: the densely woven covering tissue eventually turns black and forms the wall of the imbedded perithecia.

Stages of development earlier than this were somewhat indistinct, but they suggested that the coiled hypha arose from two similar very transparent hyphae (fig. 38) which stain very deeply with haematoxylin, one of which curved closely against the other and are analogous to the simple form of gametangia seen by Barker* in Monascus: at this stage the thin walled covering tissue was not yet formed.

*Spore discharge* extends over several weeks in detached stromata and black ascospores are produced in vast quantities. In the quiet atmosphere of a culture chamber long coiling threads of ascospores 10 or 15 mm. or longer are extruded from the mouths of the perithecia (fig. 37) which closely crowded together cover the whole exterior of the stromata. The coiled threads look very like the threads of pycnospores which are produced normally from mature pycnidia of the Sphaeropsidaceae, but they are not formed in the same way and are really abnormal. If one of these threads be observed under the microscope it will be seen to issue from the mouth in a jerky manner and on brushing aside such a thread, asci can be seen coming up to the orifice one at a time and discharging themselves one after another. The discharge goes on very rapidly and the ascospores from one ascus follow so closely on those from the preceding one that in a quiet atmosphere they stick together and a long coiling thread is produced (fig. 37), consisting of symmetrically arranged ascospores (fig. 32), for each series of eight ascospores lies parallel with another series of eight and the eight ascospores of each group can be seen adhering to one another. Sometimes an ascus appears quite a third its length above the orifice before discharging.

Under natural conditions air currents would prevent the formation of these coiled threads, for the contents of one ascus would be blown away before the discharge of the next ascus took place. Even in a quiet atmosphere the coiled threads of ascospores are not formed if the discharge of asci is taking place slowly; for by placing slips of white paper a centimeter or so above the surface of a ripe sporophore, after about an hour black ascospores will be seen spotting the white surface sometimes singly, sometimes in groups of eight.

After the asci have been discharged, numbers of ascospores remain crowded around the mouths of the perithecia; in a damp

* Barker. The Morphology and Development of the Ascocarp of Monascus. Ann. of Bot., 1903, p. 217.

to be seen in sections of young perithecial stromata of *Xylaria polymorpha*, Ustulina and other fungi: the densely woven covering tissue eventually turns black and forms the wall of the imbedded perithecia.

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J. S. Bayliss Elliott del.

atmosphere these germinate and the stroma becomes studded over with little white tufts of mycelium which appear to issue from the mouths of the perithecia: and in some instances this is the case for stromata which had apparently discharged all their ascospores were examined and some of the few ascospores which had not been set free had germinated inside the perithecia. These tufts in the course of a few days become covered with conidia; on detached ripe fruit bodies kept in a moist atmosphere under a bell jar these tufts always appear but in the open are rarely seen except on logs lying in very sheltered places.

In conclusion I wish to express my great indebtedness to the late Professor G. S. West for the loan of books of reference.

## DESCRIPTION OF PLATE VI

Fig.

31. Conidia and conidiophores from bark of ash log infected with *Daldinia concentrica*.
32. Small portion of ascospore tendril which has exuded from a perithecium.
33. Conidiophores and conidia from hanging drop culture of ascospores.
34. Section through a few exterior zones of a perithecial stroma, showing an outer layer of distinctly formed perithecia, and inner zones where previously formed perithecia are seen in various stages of distinctness.
35. Conidiophores bearing conidia growing on bark.
36. Perithecial stromata appearing on a patch of conidiophores.
37. Tendrils of ascospores arising from the mouths of perithecia which were rapidly discharging their contents in a still atmosphere.
38. Sections of very young perithecia.
39. Section of perithecium somewhat older.

# SOME OBSERVATIONS ON ERYSIPHE POLYGONI DC.

*By G. O. Searle, B.Sc., P.A.S.I.*

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The work described in this paper was carried out by the author during 1913–14 in the Mycological Department of the South-Eastern Agricultural College, Wye.

The war caused a cessation of the work in August 1914, and no opportunity of continuing the investigation or of publishing the results has occurred until now, except in the one instance given below. Though far from complete and though a considerable time has elapsed since they were undertaken, it was thought that these observations might contain sufficient points of interest to be worthy of publication.

My thanks are due to Mr E. S. Salmon for the many suggestions and great help he gave me.

The investigation, as originally conceived, fell under the following three heads:

(A) The Comparative Susceptibility of Varieties of Swedes and Turnips to the "Swede Mildew" (*Erysiphe Polygoni* DC.).

(B) The Specialisation of Parasitism within the Morphological Species *Erysiphe Polygoni* DC.

(C) The Method of Over-wintering of the "Swede Mildew" (*Erysiphe Polygoni* DC.).

(A) In the case of the first problem to be attacked, the result of the field trials for 1913 have already been published in full elsewhere (12), and will only be very briefly described here.

Samples of seed of thirty-three varieties of Swedes, forty-two varieties of Turnips and two varieties of Rape were obtained from five well-known seeds-merchants in England and Scotland.

These seeds were sown, on June 9th, 10th, and 12th, in small plots measuring ten links square, i.e. one-thousandth of an acre each, on old lucerne ley which had been ploughed and dunged but had received no artificials. The plots were cultivated and thinned in the usual way. On August 23rd the conidial stage of *Erysiphe Polygoni* was found on Swedes in a field situated at some distance from the plots, and on the 28th of August sufficient material was collected from this field to carry out the infection of the plots in the following manner.

A number of the infected leaves were picked and placed in a warm moist atmosphere for twenty-four hours to encourage the formation of conidia. The leaves were then washed in large cans of water until it became quite milky from the number of conidia contained. This spore suspension was then sprayed through a fine rose, as evenly as possible, over the seventy-seven plots. Previous to spraying a very careful examination was made but no mildew could be found on any plot. The weather was dull but no rain fell for three or four days after inoculation.

Examined on Sept. 2nd, a few minute patches of mildew were found on nearly every plot. From Sept. 6th to Oct. 9th the severity of attack was classified once a week in the following manner: Marks were assigned each week to each plot, these marks varying from 0–10 according to the severity of the attack; the plots marked 0 were those on which no trace of mildew could be found, and so on proportionately up to 10 assigned to the plots most severely attacked, and on which not a single leaf could be found free from mildew. By Oct. 9th the attack seemed to have attained its maximum severity, and on Nov. 3rd all the roots were pulled, topped, cleaned and weighed. On an average the plots contained fifty roots each.

The following are the salient points of the results.

No variety of Swede, Turnip or Rape was found to be wholly immune.

Only two varieties, both Turnips, were marked as low as "1" when the weekly readings were averaged at the end of the trials.

The Swedes were attacked more severely than the Turnips; the Rape came approximately midway between the two in the severity of the attack. The Turnips were attacked most on the underside of the leaf.

It was reported by nurserymen that, in the North of England at any rate, Bronze Top Swedes were more liable to mildew than Purple or Green Top varieties and that Purple Top Yellow is more susceptible than Green Top Yellow; this was not confirmed by the trial, a Green Top Swede being one of those averaging $9\frac{1}{6}$, whilst another Green Top averaged only $2\frac{1}{3}$, two Bronze Top varieties averaged 8.

The plots being so small, too great an experimental error was introduced to allow any reliable comparison of yields with severity of mildew attack, though it is of interest to note that the two highest yields, each 106 lbs. per plot, averaged in marking 2 in one case and $2\frac{2}{3}$ in the other; these were both Turnips.

In 1914 one hundred and four varieties were obtained, including all those previously tested, but owing to the outbreak of war the trials came to an end.

My thanks are due to the firms of Messrs Sutton & Sons, Austin & McAslan, Drummond, Little & Ballantyne and Carter for kindly providing me with the seed free.

(B) As has been conclusively proved by the work of several investigators including Neger (2), Marchal (3), Salmon (4, 5, 6) and Reed(11), many species of Erysiphaceae show that specialisation of parasitism which results in the evolution of "biologic forms," forms morphologically identical but totally distinct in their infection powers, being, in most cases that have been investigated, confined to a single species or to a few closely related species of host plants and seldom having powers of infection outside the genus.

The experiments described in this paper were undertaken with a view to extending the knowledge of this specialisation as far as the morphological species *Erysiphe Polygoni* was concerned, more especially in the case of the conidial form of that species found on cultivated Brassicae.

It may be stated here that throughout the whole investigation the perithecial stage was never found on any Brassicae, so that the oidium used in inoculations was only identified as *Erysiphe Polygoni* by its host, no other species of Erysiphaceae having, so far as I know, been reported on the genus *Brassica*.

The method of inoculation was the usual one of drawing the edge of a sterile scalpel through the patch of mildew from which the conidia were to be taken and then, after placing a drop of water on the leaf to be inoculated, drawing the edge of the scalpel through the drop thus leaving the conidia floating in it. The whole plant was then kept under a bell-jar for twenty-four hours after which the bell-jar was removed completely or raised enough for ventilation.

There was always a chance of a certain amount of natural infection taking place especially towards the end of September, although all the plants used were kept in a separate greenhouse as soon as inoculated, so only those results were accepted as positive where infection occurred at the exact spot inoculated and the remainder of the leaf was entirely free from mildew; if the remainder of the leaf showed any mildew the experiment was discarded, whether there was infection at the inoculated spot or not.

All the plants used were grown from seed in pots in a greenhouse. In each case the first sign of infection (when this occurred), was noticeable in about six days, when a small powdery patch of mycelium, visible to the naked eye, appeared.

A few general observations will first be given.

The late summer and early autumn of 1913 were characterised

by a particular abundance of mildew in the Wye district, but little was noticed earlier in the year. A very careful search for the conidial stage of *Erysiphe Polygoni* on some of its commoner hosts was made during July and August, but it was not found out of doors until August 19th on *Polygonum aviculare* and August 23rd on Swedes. On the other hand it appeared spontaneously in the greenhouse on Swedes on July 23rd and on *Polygonum aviculare* on August 2nd.

This same phenomenon was noted in other cases, the conidial stage on Turnip, Rape, *Sonchus arvensis, Linum usitatissimum, Pisum sativum, Trifolium pratense, Onobrychis sativa, Trifolium dubium, T. hybridum, T. repens, Capsella Bursa-pastoris,* and *Brassica Sinapis,* all appeared in the greenhouse at least a fortnight before they could be found out of doors even though careful daily search was made; this will be referred to later.

The first series of inoculations were with the conidia from the Swede, with a view to investigating how far the oidium on Swede was specialised in relation to other hosts of *Erysiphe Polygoni,* especially other cultivated Brassicae.

In the following tables the sign + signifies a full infection powdery with conidia and fully visible to the naked eye; the sign 0 signifies no visible infection; the sign ? signifies that a "subinfection" resulted, consisting of a few hyphae and a very few conidia visible only with a lens. The significance of subinfections will be discussed later. The sign – signifies that the experiment was discarded owing to infection appearing naturally on other spots than those inoculated.

TABLE I.

Inoculations with conidia from Swede.

| Hosts inoculated | No. of inoculations | No. of infections |
|---|---|---|
| Swede ... ... ... ... | 8 | + 8 |
| Swede (cotyledons) ... ... | 41 | +37 |
| Swede (first leaves) ... ... | 6 | + 6 |
| Turnip ... ... ... ... | 13 | +10 |
| Turnip (cotyledons) ... ... | 9 | — |
| Cabbage ... ... ... | 32 | ? 31 |
| Kohl-rabi ... ... ... | 10 | ? 7 |
| Rape ... ... ... ... | 26 | +23 |
| Broccoli ... ... ... ... | 10 | ? 9 |
| Kale (Thousand Head) ... | 33 | ? 28 |
| Charlock (*B. Sinapis*) | | |
| (*a*) Under cloches out of doors | 10 | 0 |
| (*b*) In greenhouse ... ... | 18 | — |
| (*c*) In greenhouse ... ... | 10 | +5 ? 5 |
| *Geranium molle* ... ... | 6 | 0 |
| *Ranunculus arvensis* ... ... | 7 | 0 |
| *Polygonum aviculare* ... ... | 7 | 0 |
| *Trifolium pratense* ... ... | 6 | 0 |
| *Cnicus lanceolatus* ... ... | 3 | 0 |

The above results are interesting in that they indicate that the "biologic form" of *Erysiphe Polygoni* on the Swede is able to cause a full infection on the Turnip and Rape, all three being cultivated forms of the same aggregate species *Brassica campestris* Linn., whilst it is only capable of forming a "subinfection" on Cabbage, Kohl-rabi, Broccoli and Kale, which are cultivated forms of the aggregate species *Brassica oleracea* Linn. Further, that in the case of Charlock (*B. Sinapis*) the position is very obscure as in five instances full infections resulted, in five other instances "subinfections" only appeared and in a further ten cases no infection at all took place which seems to indicate, either that there was some physiological difference between the Charlock plants used—in one case the plants used were those raised in the greenhouse from seed and in the other were plants found growing wild and simply covered with a cloche—or that some temperature or moisture factor enters into the problem.

Further it will be seen that in no case did an infection result on any of the hosts used belonging to other families.

Though no opportunity occurred of repeating and confirming these series the following year, the results indicate that the "biologic form" on Swede is confined to the aggregate species *Brassica campestris* with powers of slight infection on *B. oleracea* and probably under certain conditions on *B. Sinapis*.

TABLE II.

Inoculations with conidia from *Polygonum aviculare*.

| Host inoculated | No. of inoculations | No. of infections |
|---|---|---|
| *Polygonum aviculare* ... ... | 8 | +6 |
| Swede ... ... ... ... | 22 | 0 |
| Swede (cotyledons) ... ... | 8 | 0 |
| *Trifolium pratense* ... ... | 3 | 0 |
| Swede (first leaves) ... ... | 3 | 0 |
| Turnip (cotyledons) ... ... | 15 | 0 |

These results go to confirm the indications of Table I that the forms of *Erysiphe Polygoni* on *Polygonum aviculare* and *Brassica campestris* are distinct "biologic forms."

TABLE III.

Inoculations with conidia from *Trifolium pratense*.

| Hosts inoculated | No. of inoculations | No. of infections |
|---|---|---|
| *Trifolium pratense* ... ... | 4 | +4 |
| *T. hybridum* ... ... ... | 3 | 0 |
| *T. repens* ... ... ... | 6 | 0 |
| *Vicia Faba* ... ... ... | 8 | 0 |
| *Onobrychis sativa* ... ... | 4 | 0 |

This table indicates that the form of *Erysiphe Polygoni* on *Trifolium pratense* is specialised on that species and is unable to infect other species of the same genus or other genera of the same family, thus, as far as the experiment was carried, confirming the more extensive series carried out with the oidium on *T. pratense* by Salmon (4).

Two further experiments with clovers were tried, in one of which conidia from *Trifolium minus* were found unable to infect *T. pratense* or *Onobrychis sativa*, and in the other conidia from *Trifolium hybridum* were found unable to infect *T. repens*.

A short series was then tried with the form on *Pisum sativum*.

TABLE IV.

Inoculations with conidia from *Pisum sativum*.

| Hosts inoculated | No. of inoculations | No. of infections |
|---|---|---|
| *Pisum sativum* ... ... ... | 5 | — |
| ,, ,, ... ... ... | 15 | +10 |
| *Onobrychis sativa* ... ... | 10 | 0 |
| *Vicia Faba* ... ... ... | 24 | 0 |
| *Trifolium pratense* ... ... | 4 | 0 |

This table confirms the fact, already noted by Salmon, that the oidium on *Pisum sativum* should rank as a "biologic form."

A single experiment with the oidium on *Capsella Bursa-pastoris* showed that the conidia, though able to infect fully *Capsella Bursa-pastoris* (six inoculations), were unable to infect the Swede (six inoculations).

In confirmation of Table I a further experiment with the conidia from Rape was tried; in this case eight inoculations on Turnip caused six full infections, but ten inoculations on Kohl-rabi produced no infections, whereas one would have expected that "subinfections" would have resulted.

All the above inoculations were carried out between July 29th and Sept. 26th after which date the spread of natural infection in the greenhouse was so general that further trials were entirely vitiated.

A number of series was then commenced in the laboratory employing excised leaves placed on moist filter paper in Petri dishes, and pieces of stem placed in larger dishes. These experiments gave some interesting results especially in their bearing on the growth of species of the Erysiphaceae on internal tissues of plants in contradistinction to their usual ectoparasitic existence. This phenomenon had already been noted by Salmon (10) when working with *Erysiphe graminis*.

Before describing these series it will be necessary to deal

briefly with the question of "subinfections." Salmon (4) (pp. 270–271) in his work on *Erysiphe graminis* and the Bromes found that in some inoculations the only result was a few minute flecks of mycelium and a few scattered conidiophores; in some cases these minute infections disappeared within a few days and in others small flecks of mycelium persisted. He came to the conclusion that a faint infection does actually occur and that the flecks of mycelium and few conidiophores are not merely the production of a conidium germinating and living independently for a short time. He called these slight infections "subinfections."

In the work described here the phenomenon of "subinfections" was encountered early. As will be seen from Table I above, inoculation of conidia from Swede on to cultivated species of *Brassica oleracea* invariably produced "subinfections" only. However in these particular cases of "subinfections" there is another detail to be taken into account and that is the distinct discolouration of the epidermis of the host which takes place. Superficially the epidermis at a point where a "subinfection" is present shows a series of minute black spots giving the appearance of local death of the cells. In section it was found that in some cases only an epidermal cell or a small group of cells were affected, the walls being very dark brown and the cells being filled with a dark brown disorganised content so dense that it was impossible to determine if normal haustoria had been formed or not; in other cases the discolouration radiated into the subepidermal cells changing the cell walls to a dark brown colour and sometimes the cell content also.

The discolouration of the epidermis by species of Erysiphaceae has been noted by several investigators and was discussed by Grant Smith (1), but the discolouration noted by him did not seem to be of such an extreme nature as that under consideration now, as Grant Smith says it was not noticeable in sections when cut and stained and seemingly normal haustoria were visible. In fact the discolouration was so distinct in the present instance that by its means the phenomenon of "subinfection" was later discovered in the field. Salmon ((4) p. 270) says, "It may be that, in some cases under certain favourable conditions the fungus could exist permanently and increase on such a host plant." That this is the case at any rate with "subinfections" on cultivated *Brassica oleracea* is confirmed by the following field observations.

*Oct.* 1913. After long search a Rape plant severely infected with the oidium of *Erysiphe Polygoni* was discovered in the centre of a large field of Kohl-rabi. An investigation of the Kohl-rabi plants showed that all those plants within a few yards

of the Rape plant had their leaves and stems covered with minute black spots, which, examined microscopically, were found to be wherever minute flecks of mycelium were present. This mycelium was quite easy to trace to the large numbers of conidia to be distinctly seen scattered over the surface. The area of infection was quite local as Kohl-rabi plants at more than five to six yards from the Rape plant only showed very few "subinfections." Under the circumstances it seemed to be a permissible conclusion to take the Rape plant as the centre of infection.

A few days later the same effect was seen in the case of Cabbages, again round a chance plant of Rape growing amongst them. The appearance in this case was exactly similar to the "subinfection" on the Kohl-rabi plants and again the Cabbages further away from the Rape plant were unaffected.

Then the phenomenon was noted on Brussels Sprouts; in this case they were some plants growing near the Swede plots used in the first investigation (A). Here the "subinfections" were much more distinct and generally, though not entirely, confined to the petioles; they showed up distinctly to the naked eye as patches, $\frac{1}{8}$ to $\frac{1}{2}$ inch across, of minute black spots, the patches being rather symmetrical in shape as though the overlying mycelium was formed by the growth from a single conidium. In every case a few conidiophores and conidia could be seen.

The last case noted was on the cultivated Brassica known as Marrow-stemmed Kale. In this case the appearance was very distinctive as under the microscope the black spots were found to follow the course of the hyphae at regular intervals giving a dendritic appearance and making it look almost certain that the spots were formed wherever a haustorium had entered or endeavoured to enter the epidermal cells.

*Nov. 27th.* The weather had been exceptionally warm and moist. "Subinfections" on Marrow-stemmed Kale became much more vigorous and such a large number of conidia had been formed that the characteristic discolouration could hardly be seen. However the mycelium had not spread beyond its former limits. The same happened to a slighter extent on the Brussels Sprouts.

*Dec. 6th.* Weather decidedly colder. Some "subinfections" on Marrow-stemmed Kale had spread $\frac{1}{4}$ inch beyond the discoloured patch without further discolouration being formed, but very few conidia were to be found on the new mycelium. Some "subinfections" on Brussels Sprouts had now developed into full infections, in this case also without further discolouration.

*Dec. 10th.* "Subinfections" on Marrow-stemmed Kale were observed on specimens exhibited at Messrs Garton's stand at

Smithfield Show. On enquiry it was found that the Kale had been grown in Norfolk.

*Dec. 15th.* After several hard frosts it was noted that the "subinfections" were still present on Marrow-stemmed Kale but only very few conidia could be seen. The infections on Brussels Sprouts were quite vigorous with a number of young conidiophores and conidia. On Rape fresh looking powdery patches of mildew were numerous. On Swede it was now difficult to find any mildew except on the lower surface of the leaves.

*Dec. 17th.* A number of fresh spots of mildew were found on the under surface of Swede leaves, all of them were quite powdery with conidia. "Subinfections" were very numerous on Thousand Head Kale.

*Jan. 6th.* During the previous fortnight the temperature dropped at times to 17° F. and there had been several inches of snow. "Subinfections" on Thousand Head Kale were found to be in a quite healthy condition. Small patches of mycelium were found on Swedes but without conidia.

*Jan. 13th.* Thousand Head Kale leaves, covered with snow, were collected, and under the snow were found seemingly healthy patches of mycelium. These leaves were brought into a warm laboratory and in a few days developed a large number of conidia on the patches of mycelium.

*Jan. 26th.* Temperature during previous week at times dropped to 12° F.

*March 7th.* Thousand Head Kale observed with small "subinfections" still alive and a few conidia.

*Early May.* "Subinfections" on Thousand Head Kale and Marrow-stemmed Kale in the same dormant condition.

*Mid-May.* "Subinfections" on a Thousand Head Kale plant commenced to spread first on to the lower leaves and then on to the new upper leaves. Infections then appeared on a Rape plant and a Swede plant standing next to the Kale.

It would appear therefore from the above observations that an actual infection of the plant does occur in the case of "subinfections" and that it is quite possible in Nature for a "subinfection" to continue existence as such and later grow out into a full infection.

As these "subinfections" have been found to occur quite naturally in the field, it shows that they are not merely a phenomenon caused by carrying out inoculations under cultural conditions, nor do they depend on a large number of conidia being sown on one spot as suggested by Salmon (7), though that may be the cause in certain cases, noted with artificial inoculations.

It would seem possible that "subinfections" are the pre-

liminary stages of the spread of the fungus on to a new host, especially since, as it is shown later, the conidia formed on the "subinfection" are fully viable.

The first series undertaken in the laboratory was one using conidia from the Swede and Rape. Inoculations were performed on leaves in water under a bell-jar.

TABLE V.

Conidia from Swede.

| Date | Host used | No. of inoculations | No. of infections | Remarks |
|---|---|---|---|---|
| Nov. 21 | Swede ... | 4 | +4 | |
| ,, | Turnip ... | 2 | +2 | |
| ,, | Rape ... | 2 | +2 | |
| ,, | Kohl-rabi | 2 | — | Leaf died |
| Nov. 29 | Swede ... | 4 | +4 | |
| ,, | Kohl-rabi | 8 | ? 7 | With discolouration |

Conidia from Rape.

| | | | | |
|---|---|---|---|---|
| Nov. 21 | Rape ... | 2 | +2 | |
| ,, | Kohl-rabi | 2 | ? 2 | |

This table shows the typical results already noted in Table I.

Two experiments with conidia from "subinfections" on Marrow-stemmed Kale were then tried; four inoculations on to Kohl-rabi leaves gave four "subinfections" but with no visible discolouration of the epidermis; four inoculations on to Swede leaves gave four full infections. These two experiments prove the viability of conidia formed on "subinfections."

It was now decided to carry out several series to test how far the fungus could adapt itself to continued life on the internal tissues of various hosts and to observe if any differences in infective power took place under such conditions. These series were carried out in large Petri dishes lined with moist filter paper, and kept at a temperature varying between 50–60° F.

The following abbreviations are used:

"Cut M.S.K." = A piece of stem of Marrow-stemmed Kale approx. 3 inches long and $1\frac{1}{2}$ inches diam. cut in half lengthwise, so that it is about $\frac{3}{4}$ inch thick and then a sloping cut made in the upper uninjured surface to remove a wedge-shaped piece of tissue, leaving the internal tissue exposed to about $\frac{1}{8}$ inch deep. Conidia were then sown on the internal surface thus exposed. This was found to be a convenient size to use in large Petri dishes and kept fresh a long time.

"Cut ... petiole" = A piece of petiole, of host used, about $2\frac{1}{2}$ inches long with a wedge-shaped piece cut out leaving internal tissue exposed to $\frac{1}{8}$ inch deep.

SERIES A. Commenced Dec. 9th. Conidia from sources shown.

One inoculation in each experiment.

| No. of Expt. | Source of conidia | Host used | Result | Remarks |
|---|---|---|---|---|
| A 1. | Swede ... | Inner surface of $\frac{1}{16}$" thick strip of M.S.K. stem | Full infection | Grew very slowly at first only a few hyphae by Dec. 17. Full inf. Jan. 6th |
| A 2. | Brussels Sprout (subinfection) | ,, ,, | Full infection | ,, ,, |
| A 3. | Swede ... | Outer surface ditto. | — | Overrun by mould |
| A 4. | Brussels Sprout | ,, ,, | — | Conidia germinated but overrun with mould |
| A 5. | Swede ... | ,, ,, | Full infection | Strong mycelium and many conidia by Dec. 17th |
| A 6. | Brussels Sprout | ,, ,, | Full infection | Strong mycelium by Dec. 17th |
| A 7. | Swede ... | "Cut M.S.K." | Full infection | Both showed strong mycelium and many conidia Dec. 15th. |
| A 8. | Brussels Sprout | ,, ,, | Full infection | Both showed a discolouration of the host cells |
| A 9. | Swede ... | B. Sprout petiole epidermis removed | — | Slight mycelium Dec. 17th then died out |
| A 10. | Brussels Sprout | ,, ,, | Full infection | |
| A 11. | Swede ... | M.S.K. petiole, epidermis removed | Full infection | Strong mycelium with many conidia by Dec. 15th. Later spread to uninjured surface where it discoloured the cells |
| A 12. | Brussels Sprout | ,, ,, | Full infection | |
| A 13. | Swede ... | "Cut M.S.K." $\frac{1}{32}$ inch deep | — | Strong mycelium and many conidia Dec. 17th but died by Jan. 6th |
| A 14. | Brussels Sprout | ,, ,, | — | Very weak mycelium Dec. 17th then died out |
| A 15. | Rape ... | "Cut M.S.K. petiole" | Full infection | Strong growth with conidia Dec. 17th. Later spread to and discoloured the cells of uninjured surface |
| A 16. | Swede ... | B. Sprout petiole small piece of epidermis removed | Full infection | Spread without discolouration |
| A 17. | Brussels Sprout | ,, ,, | Full infection | Spread on to uninjured surface without discolouration |
| A 18. | Swede ... | "Cut B. Sprout petiole" | Full infection | Spread without discolouration to uninjured surface |

SERIES A. Commenced Dec. 9th. Conidia from sources shown (contd.)

One inoculation in each experiment.

| No. of Expt. | Source of conidia | Host used | Result | Remarks |
|---|---|---|---|---|
| A 19. | Swede ... | Uninjured surface M.S.K. stem | Full infection | |
| A 20. | Swede ... | ,, ,, | — | Few hyphae formed then died out |
| A 21. | Rape ... | ,, ,, | 0 | |
| A 22. | Brussels Sprout | ,, ,, | 0 | |
| A 23. | Brussels Sprout | ,, ,, | — | Few hyphae formed then died out |

The above results show that the "biologic form" of *Erysiphe Polygoni* on cultivated Brassicae is able to live and produce conidia when sown on the internal tissue of its host instead of the epidermis. Further that when the form on varieties of *Brassica campestris* was sown on varieties of *B. oleracea*, which had been injured by cutting, full infections resulted instead of the usual "subinfections." It is also of interest to note that in some cases (e.g. A 7 and A 15) the cells of the host underwent the typical discolouration even though a full infection finally resulted; this discolouration was more notable however when the mycelium spread to the uninjured epidermal cells.

In view of the difficulty of keeping cultures of species of Erysiphe for any length of time owing to its obligate parasitism, it is worthy of note how useful the cut stem of Marrow-stemmed Kale was found to be. This material kept remarkably fresh in a large Petri dish on wet filter paper and, on the whole, remarkably free from saprophytic fungi. As an instance it may be noted that a piece of cut Marrow-stemmed Kale stem after fifty-nine days in a Petri dish showed a perfectly healthy patch of new mycelium with numerous chains of ripe conidia.

By carrying out the inoculations in December, taking pieces of Marrow-stemmed Kale from plants distant from those carrying subinfections, and by sterilising Petri dishes, it was possible to reduce the chances of natural infection to a negligible quantity, especially as the inoculations were carried out on freshly cut surfaces.

The second series (B) was carried out in extension of the first and also to test the viability of the conidia produced in series A.

This series shows the full viability of conidia produced by mycelium on cut surfaces; also that the distinctive discolouration cannot be entirely correlated with the source of the conidia in the first generation.

As in Series A the inoculations on uninjured Marrow-stemmed Kale seemed to fail under cultural conditions and Brussels

Sprout petiole was found much less satisfactory to keep in Petri dishes than Marrow-stemmed Kale, since it very quickly became attacked by various bacteria and moulds and rotted.

SERIES B. Started Dec. 20th. Conidia from sources shown. One inoculation in each case.

| No. of Expt. | Source of conidia | Host used | Result | Remarks |
|---|---|---|---|---|
| B 1. | A 7 | "Cut M.S.K." | Nearly full infection | A number of conidia. Medium discolouration |
| B 2. | A 12 | ,, ,, | Full infection | Powdery patches of conidia. Very little discolouration |
| B 3. | A 11 | ,, ,, | Full infection | Powdery patches of conidia. Great discolouration |
| B 4. | A 8 | ,, ,, | Full infection | Powdery patches just visible. Very strong discolouration |
| B 5. | Swede | ,, ,, | Slight infection | Healthy mycelium. Few conidia. Slight discolouration |
| B 6. | Marrow-stemmed Kale | ,, ,, | Full infection | Powdery patches of conidia. Very slight discolouration |
| B 7. | ,, ,, | M.S.K. stem uninjured surface | 0 | |
| B 8. | Brussels Sprout | ,, ,, | 0 | |
| B 9. | Marrow-stemmed Kale | "Cut B. Sprout petiole" | — | |
| B 10. | Swede ... | ,, ,, | — | Slight mycelium and young conidia. Then rotted |
| B 11. | Brussels Sprout | ,, ,, | 0 | |
| B 12. | Brussels Sprout | B. Sprout petiole uninjured surface | 0 | |

Series C was undertaken to test the viability of the conidia when carried to the third generation on cut surfaces.

SERIES C. Started Jan. 22nd. Conidia from sources shown. One inoculation in each case.

| No. of Expt. | Source of conidia | Host used | Result | Remarks |
|---|---|---|---|---|
| C 1. | B 6 | "Cut M.S.K." | Full infection | Large powdery patches. Very numerous conidia. Strong discolouration |
| C 2. | B 1 | ,, ,, | Slight infection | Few conidia. Wound being overgrown by callus |
| C 3. | B 2 | ,, ,, | Full infection | |
| C 4. | Thousand Head Kale | ,, ,, | Full infection | Powdery patches. Very numerous conidia. Slight discolouration |

The next series (D) carried on the fungus to the fourth generation on cut surfaces.

SERIES D. Started Feb. 12th. Conidia from sources shown.

One inoculation in each case.

| No. of Expt. | Source of conidia | Host used | Result | Remarks |
|---|---|---|---|---|
| D 1. | C 1 | "Cut M.S.K." | Full infection | Patches powdery with conidia. Very distinct discolouration |
| D 2. | C 3 | ,, ,, | Medium infection | Fairly numerous conidia. Very distinct discolouration |
| D 3. | C 4 | ,, ,, | Medium infection | ,, ,, |

An attempt was made on March 6th to carry on to the fifth generation on cut Marrow-stemmed Kale stem but the Kale was by this time too old and all the pieces used soon died and rotted.

However the above series show that it is possible to carry on cultures of an Erysiphe on the exposed internal tissues of its host over four generations in three months.

An experiment was then tried to demonstrate whether infection would take place on the internal tissue of the swollen hypocotyl ("root") of the Swede in the same way as on the stem of the Marrow-stemmed Kale.

SERIES 1 S 1. Started Jan. 28th. Conidia from sources shown.

One inoculation in each case.

| No. of Expt. | Source of conidia | Host used | Result | Remarks |
|---|---|---|---|---|
| 1 S 1. | Swede | "Cut surface Swede root" | Full infection | Large number young conidia Feb. 12th |
| 1 S 2. | B 3 | ,, ,, | ,, ,, | One or two patches powdery with conidia Feb. 12th |
| 1 S 3. | B 6 | ,, ,, | ,, ,, | ,, ,, |
| 1 S 4. | Thousand Head Kale (subinfection) | ,, ,, | ,, ,, | Large patch powdery with conidia Feb. 12th |
| 1 S 5. | Marrow-stemmed Kale (subinfection) | ,, ,, | ,, ,, | Large patch powdery with conidia Feb. 12th |

This series shows that infection took place quite successfully on the internal tissue of Swede "root." In no case was there any discolouration shown.

An attempt was made to carry this series on to another

generation but in each case the Swede rotted before any result could be obtained.

The internal tissue of an epicotyl, in this case the swollen epicotyl of the Kohl-rabi, was used in the next series.

SERIES 2 K. Started Feb. 12th. Conidia from sources shown.

One inoculation in each case.

| No. of Expt. | Source of conidia | Host used | Results | Remarks |
|---|---|---|---|---|
| 2 K 1. | Rape | "Cut surface Kohl-rabi epicotyl" | Slight infection | A few young conidia. Slight discolouration |
| 2 K 2. | Brussels Sprout | ,, ,, | 0 | — |
| 2 K 3. | Swede | ,, ,, | Medium infection | Fairly numerous conidia. Very slight discolouration |
| 2 K 4. | 1 S 5 | ,, ,, | 0 | — |
| 2 K 5. | C 1 | ,, ,, | Medium infection | ,, ,, |

The last two series certainly indicate that, however far species of Erysiphe may be specialised as to their hosts, the infection powers are always constant within that host whatever part is used for inoculation. This is specially noticeable if one traces the genealogy of 2 K 5, which, starting as conidia from a "subinfection" on Marrow-stemmed Kale, passed two successive generations on the internal tissues of Marrow-stemmed Kale and finally produced conidia again on the internal tissue of the epicotyl of Kohl-rabi; or the example of 1 S 2, which started as conidia from a full infection on the uninjured epidermis of a Swede leaf, spent one generation on the outermost cells of the cortex of the Marrow-stemmed Kale stem, one generation on the innermost layers of cortex and vascular tissues of the same, and finally successfully produced a full infection on the internal tissue of a Swede hypocotyl. In the latter case conidia from 1 S 2 were, on Feb. 12th, inoculated on to "cut M.S.K." again and by Feb. 23rd gave a slight infection showing a few conidia and distinct discolouration.

The last series to be undertaken was to demonstrate the infection powers of conidia from "subinfections" when inoculated on to the uninjured surface of various hosts usually only bearing "subinfections," i.e. cultivated varieties of *Brassica oleracea*. A few inoculations on to varieties of *B. campestris* were included as controls.

In each case uninjured leaves in water under bell-jars were used as hosts.

The signs used have the following significance: — = Experi-

ment discarded, usually through death of leaf; 0 = No infection; ? = Subinfection; :– = Medium infection, rather more than subinfection; + = Full infection.

## Table VI.

### Conidia from sources shown.

| Date | Source of conidia | Host used | No. of inoculations | | Result |
|---|---|---|---|---|---|
| Jan. 20 | B. Sprout ? | M. S. Kale | 4 | :–4 | Distinct discolouration |
| ,, | ,, ,, | Thousand Head Kale | 4 | +4 | Very slight discolouration |
| ,, | ,, ,, | B. Sprout | 4 | +4 | |
| ,, | Marrow-stemmed Kale ? | B. Sprout | 4 | +4 | |
| ,, | ,, ,, | Thousand Head Kale | 4 | ? 2 | +2 |
| ,, | ,, ,, | M. S. Kale | 4 | ? 4 | Slight discolouration |
| ,, | ,, ,, | Swede | 4 | — | Leaf died |
| ,, | A 5 | M. S. Kale | 4 | ? 4 | Leaf died early |
| Jan. 26 | Marrow-stemmed Kale ? | Turnip | 4 | +4 | |
| ,, | ,, ,, | Rape | 4 | +4 | |
| ,, | ,, ,, | M. S. Kale | 4 | ? 4 | |
| ,, | B. Sprout ? | Turnip | 4 | +4 | |
| ,, | ,, ,, | B. Sprout | 4 | :–2<br>+2 | Distinct discolouration |
| ,, | Thousand Head Kale ? | B. Sprout | 4 | :–4 | |
| ,, | ,, ,, | M. S. Kale | 4 | ? 4 | Very slight |
| ,, | ,, ,, | Thousand Head Kale | 4 | ? 4 | |
| Feb. 26 | B. Sprout? | B. Sprout | 2 | :–2 | Fair amount mycelium. Few conidia. Some discolouration |
| ,, | ,, ,, | M. S. Kale | 2 | :–2 | Fair amount mycelium. Few conidia. Distinct discolouration |
| ,, | ,, ,, | Thousand Head Kale | 2 | ? 2 | |
| ,, | Marrow-stemmed Kale ? | B. Sprout | 2 | :–2 | No discolouration |
| ,, | ,, ,, | M. S. Kale | 2 | :–2 | Few conidia. Some discolouration |
| ,, | ,, ,, | Thousand Head Kale | 2 | ? 2 | Some discolouration |
| ,, | Swede + | Rape | 4 | +4 | Large quantity mycelium. Few conidia |
| ,, | ,, ,, | Turnip | 4 | +3 | One leaf died |

These results show that, under cultural conditions,

1. Conidia from "subinfections" on varieties of *Brassica oleracea* are quite capable of giving full infections on varieties of *B. campestris*.

2. Conidia from "subinfections" on varieties of *Brassica oleracea* when sown on *B. oleracea* sometimes give full infections, though more usually they give "subinfections" or medium infections which cannot quite be classed as full infections.

It is hoped to be able to carry out soon a much longer series of similar inoculations, including also hybrids between *Brassica campestris* and *B. oleracea*, so that definite conclusions may be drawn as to the relative infection powers of conidia taken from "subinfections" on *B. oleracea* and full infections on *B. campestris*.

(C) In the case of *Erysiphe Polygoni* on cultivated Brassicae the method of over-wintering must be restricted to one or more of the following:

1. Perithecia.
2. Persistent mycelium.
3. Re-infection in the spring direct from other hosts of *Erysiphe Polygoni*, or by spores from "bridging species."
4. "Subinfections" within the genus Brassica.

The perithecial stage of the fungus is very seldom found on the cultivated Brassicae. In fact the writer, though making constant search, failed to discover perithecia on these hosts during the whole course of the investigation. Of course this does not imply that they never occur, but they are of such rare occurrence that alternative No. 1 above can be ruled out as a negligible method for the fungus of over-wintering.

In face of the experiments described in this paper and the large number of other experiments which have been carried out with other species of Erysiphe, all of which go to prove the extreme specialisation of parasitism of this genus of fungi, it seems permissible to lay down definitely that alternative No. 3 is also highly improbable; even though one takes into consideration the possibility of "biologic forms" breaking down, either under certain climatic conditions which, as far as the writer knows, has not been shown to occur by any investigator, or of their breaking down by reason of various injuries to the host, as has been demonstrated by Salmon (8, 9).

Even in the case of such a very closely related species as *Brassica Sinapis* there is a certain amount of doubt as to the free transference of the mildew to the species *B. campestris* and *B. oleracea* though it is possible that Charlock does help in a small degree in the reinfection of varieties of the cultivated

Brassicae in spring, though in this case again perithecia are equally rare.

It would therefore seem more probable from the experiments and field observations already described (although they are far from complete) that alternatives No. 2 and No. 4 are the most likely methods by which the mildew exists over the winter.

One or more of the cultivated Brassicae are always to be found in leaf at all seasons of the year on a farm, and above it has been shown that the conidial stage of the mildew was successfully kept under observation out-of-doors on one or other cultivated Brassica during the autumn, winter and round to the middle of the following May, and that, even after heavy frosts, viable conidia were formed.

As Swedes and Turnips are not often present on the farm in the spring, it is probable that infection is carried on mainly by "subinfections" on varieties of *Brassica oleracea* (which are generally to be found throughout the early spring in the form of Cabbage or Kale), aided by persistent mycelium on "volunteer" plants of Swede, Turnip or Rape.

It may be argued that it is difficult to understand why, if the mildew is able to attack Swedes and Turnips in the cotyledon stage as has been shown to be the case, it is not usual to find a bad attack before July when the plants are well advanced, but it would seem that this depends largely on climatic conditions, which have not yet been fully investigated. It will be remembered that the "subinfections" on Thousand Head Kale did not develop into distinct visible full infections until the middle of May and it is quite possible that infection may take place but the mildew remain in an undeveloped form invisible to the naked eye, until climatic conditions are suitable. Such an explanation would account for the fact, mentioned early in this paper, that numerous forms of *Erysiphe Polygoni* appeared spontaneously in the greenhouse some time before they could be found out-of-doors, presumably because the temperature of the greenhouse was more suitable for the full development of the fungus.

## Summary.

1. In field trials in 1913 no variety, out of seventy-seven varieties of Swedes, Turnips and Rape, was found to be immune to *Erysiphe Polygoni* DC. Swedes were attacked more severely than Turnips.

2. In inoculation experiments with cultivated varieties of *Brassica campestris* and *B. oleracea*, the form of *Erysiphe Polygoni* infecting these varieties was found to be a "biologic form" with this additional distinction that inoculations from

*B. campestris* to *B. oleracea* invariably gave "subinfections" as the result.

3. "Biologic forms" on *Polygonum aviculare, Trifolium pratense* and *Pisum sativum* were indicated.

4. "Subinfections" on varieties of *B. oleracea* were observed in the field and found to exist over the winter and in some cases grow into full infections.

5. Inoculations were undertaken in the laboratory and were successful both on uninjured leaves and on the internal tissues of stems; these latter were carried as far as the fourth generation.

6. Inoculations with conidia from "subinfections" were carried out and the conidia shown to be viable.

7. It is suggested that the most probable method of overwintering of the "biologic form" of *Erysiphe Polygoni* on the cultivated Brassicae is by means of "subinfections" on varieties of *B. oleracea* aided by persistent mycelium on varieties of *B. campestris.*

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# UPON THE VISIBILITY OF SPORE DISSEMINATION IN FOMES PINICOLA (SWARTZ.) FR.

*By R. E. Stone, Ph.D.*
(Department of Botany, Ontario Agricultural College.)

The larger fungi liberate millions of spores and yet the dissemination of the spores has not often been directly seen. Buller* has observed this phenomenon probably in more species than any one else, and he has devised a number of methods for detecting it. With the naked eye he saw spore clouds leaving the under surface of a fruit-body of *Polyporus squamosus* for thirteen days in succession†. The following observations were made by myself upon a fruit-body of *Fomes pinicola* in a wood near Guelph, Ontario, and I am recording them at Professor Buller's suggestion.

In May, 1917, I was collecting fungi in a dense poplar and white spruce swamp. Having become tired I sat down on a fence a short distance from a large stump from which was protruding a fruit-body of *Fomes pinicola*. The fungus was directly between myself and the sun and it was brightly illuminated by rays of light penetrating through the dense foliage. I distinctly saw clouds of spores streaming from the under side of the fruit-body and drifting away in the very slight air currents that were moving between the trees.

* A. H. R. Buller, Researches on Fungi. London, 1909, pp. 89–101, 133–147.
† *Ibid.* p. 90.

# UPON THE AUDIBILITY OF SPORE DISCHARGE IN HELVELLA ELASTICA (BULL.).

*By R. E. Stone, Ph.D.*

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The forcible discharge of spores has been observed in a great many Ascomycetes. The spore-discharging organs or asci of these fungi are very minute. Hence it is that the sound which they emit when they explode has been heard only in the case of a few species with large fruit-bodies.

Buller* has confirmed the observations of Grove that the discharge of the sporangium in *Pilobolus* is accompanied by a distinct sound. De Bary† reports hearing a hissing sound accompanying the puffing of *Peziza acetabulum* and *Helvella crispa*, thus substantiating the earlier report of Desmazières. In this connection some observations of my own on the audibility of spore discharge in *Helvella elastica* may prove of interest.

In June, 1915, the Ascomycete *Helvella elastica* was very abundant in the neighbourhood of the Agricultural College at Guelph, Ontario. On June 21 I collected many fruit-bodies of this fungus and brought them into the laboratory where I left them in a closed basket. The next day, while I was identifying species in the laboratory, my attention was attracted by an intermittent hissing sound apparently coming from the direction of the basket containing the fungi. The basket was five to six feet away from me. The room was very quiet and the sound was quite distinct. My curiosity having been aroused, I took the trouble to locate the source of the sound. All sources were soon eliminated except the basket containing the Helvella. Upon lifting the cover of the basket I clearly saw a spore-puff and at the same time heard a distinct hiss, louder than any I had heard before. In the course of half an hour I observed at least six puffs; and each puff was accompanied by a distinct hiss. The more pronounced the puff, the more audible, the more distinct, and the more prolonged were the accompanying hissing sounds.

The above observations have convinced me that at least for some of the larger Ascomycetes there can be no doubt whatever that the discharge of the spores is audible.

In conclusion I wish to thank Professor Buller for suggesting that I should write this brief communication.

* A. H. R. Buller, Researches on Fungi. London, 1909, p. 259.

† De Bary, Comparative Morphology and Biology of the Fungi, etc. Oxford, 1887, p. 92.

# PIMINA PARASITICA GROVE.

*By A. Lorrain Smith, F.L.S.*

This peculiar fungus which was discovered by Greenwood Pim growing on the hyphae of *Botrytis* sp. was described by Grove as gen. and nov. sp. in Journ. Bot. XXVI. p. 206, 1888. Pim himself published a photographic plate of the fungus with a description in the second number of the Trans. Brit. Mycol. Soc., Vol. I. p. 65, 1898. A microscopic preparation was placed in the herbarium of the British Museum.

In more recent years a fungus occurring among moulds on the cork of a bottle of preserved fruits has been described at length by P. Vuillemin as *Urophiala* gen. and nov. sp. (Bull. Soc. Sci. Nancy, Sér. 3, XI. p. 158 (pls. 4–5), 1910). The description and figures leave absolutely no doubt that he was dealing with the same genus if not the same species.

The genus is of particular interest as Vuillemin has given it an important place in his scheme of classification of the Hyphales or Hyphomycetes. In this scheme, he insists on the systematic importance of the insertion of the spore or conidium. He distinguishes four different types of insertion: the conidia may be borne (1) directly on the hyphae; (2) at the top of a conidiophore; (3) on a specialised cell or sterigma which he terms a phialide to distinguish it from the sterigma of the Basidiomycetes, or (4) on a phialide which rises from a specialised cell or prophialide. These he groups as four orders:

I. Sporotricheae: spores borne directly on the hyphae, ex. *Sporotrichum.*

II. Sporophoreae: spores borne directly on a sporophore, ex. *Acremonium.*

III. Phialideae: spores borne on a sterigma or phialide, ex. *Spicaria.*

IV. Prophialideae: phialide rising from a prophialide, ex. *Urophiala* (*Pimina*).

In the last order Vuillemin places three families each containing one genus, I. Urophialaceae, II. Coemansiaceae, III. Coronellaceae.

His descriptions of *Urophiala* are as follows:

*Urophiala* Vuill. nov. gen.

Mycelium creeping, subhyaline; fertile hyphae erect, dark-coloured septate, simple, always of three parts: (1) a continuous or uni-septate stalk; (2) the head (or prophialide) brown, incurved bearing three, rarely two, spore bearing phialides; (3) apical filaments faintly coloured. Phialides ventricose, the apex curved, beaked, soft, soon evanescent, rarely rigid. Conidia solitary, acrogenous, hyaline, round or oblong, smooth.

*Urophiala mycophila* nov. spec.

Mycelium effuse, creeping, ca. 1$\mu$ thick; fertile hyphae fuliginous, 20–34$\mu$ high; stalk 4–17 × 2·5–4$\mu$; prophialide 9–11$\mu$ high, 4$\mu$ thick, to 7–7·5$\mu$ wide, with apical filament 6–8 × 1·75–2$\mu$; phialide subhyaline, ascending, 4 × 3–3·5$\mu$; conidia ovoid, 5–7 × 4–5$\mu$.

On cork among Mucedineae. Cultivated in a test-tube on carrot. Beyond stating that the fungus grows in association with moulds, Vuillemin does not say that it is parasitic, and there is also no clear evidence that our British species is parasitic on the *Botrytis*. The microscopic preparation is somewhat imperfect, but the prophialides correspond exactly in form with the French specimens. *Pimina* is closely associated with *Botrytis* conidiophores and may be parasitic but it also grows outside the "host" filament. Vuillemin to whom the matter has been submitted recognises the generic resemblance of the plants but considers them specifically distinct as Grove's plant is on the whole larger. It seems impossible to be absolutely sure until fresh specimens are found. Vuillemin is of opinion that Grove's genus should rank as a *nomen nudum* on account of the very imperfect description which applies more nearly to *Urobasidium*.

If Vuillemin's contention be accepted, the British species would become *Urophiala parasitica*, but if as unfortunately seems probable *Pimina* should be held to have true priority then the French species would become *P. mycophila*.

# JAMES WILLIAM HELENUS TRAIL.

(1851—1919.)

*By J. Ramsbottom.*

James William Helenus Trail, Professor of Botany at Aberdeen, died on Sept. 18th last. He was born at Orkney and was the son of a parish minister who afterwards became Professor of Systematic Theology at Aberdeen. As, in addition, his maternal grandfather was a Professor of Moral Philosophy it is not to be wondered at that his early training was all on the side of the humanities. But, even in his schoolboy days Trail began that systematic collecting which he was to carry on until his death. In spite of lack of encouragement, when he graduated in arts at Aberdeen in 1870 he did so with honours in natural science. He then entered the medical faculty not apparently with any idea of eventually practising, but for the purpose of further scientific training. However, having an opportunity of visiting Brazil as botanist to an expedition organised by the Amazon Steam Navigation Company he left his medical studies for a couple of years.

His work on his botanical and zoological collections brought him into notice and in 1876 he was appointed government botanist to British Guiana. Before he sailed, however, Professor Dickie who was in failing health resigned from the botanical chair and Trail, at the age of twenty-six, was appointed by the Crown to fill the vacancy. From the year 1870 onwards Trail contributed a series of papers and notes on various natural history subjects. He early became interested in systematic mycology being first attracted by parasitic microfungi probably because of his intensive work on phanerogams and on galls. He published valuable revisions of the Scottish species of Peronosporeae, Sphaeropsideae and Melanconieae, Discomycetes, Uredineae and Ustilagineae, and Perisporiaceae, in all of which he made noteworthy additions to the British fungus flora. He contributed to the Scottish Naturalist from its foundation in 1871 and became its Editor from 1883 until 1892 when it was incorporated in the Annals of Scottish Natural History of which he was botanical editor until 1911.

A hint as to his all-round knowledge is given by the fact that when he was a medical student he acted as assistant to the

Professors of Botany, Chemistry and Natural History: and when Professor Nicol retired from the Chair of Natural History in 1878 he held the professorship until a new appointment was made.

The present writer knew of Trail's personality chiefly through meeting his students: it is not usual in these days to encounter such whole-hearted enthusiasm as to a professor's stores of knowledge long after removal from his direct influence. One had only to converse with him on systematic mycology—facts and philosophies—to understand to some extent the admiration in which he was held by those who received their botanical training from him.

One characteristic of Trail was his generosity in the cause of natural science. In 1902 he endowed the Nicol prize in Zoology and the Dickie prizes in Botany at Aberdeen "for the purpose of encouraging students to undertake research in the fauna and flora of Scotland": in 1907 the Helen Scott fund in memory of his mother for the benefit of students in any faculty showing marked ability in botany or zoology who might require assistance to enable them to follow out their studies at the University: in 1909 the Trail fund of the Linnean Society for the presentation of a medal every five years for research during the interval throwing light upon the nature of protoplasm or the physical basis of life.

Trail was elected F.R.S. in 1893 and was president of Section K at the British Association in 1910. He was president of our Society for 1902. I am indebted to an obituary notice by Sir David Prain in Kew Bulletin (1919) for much information. A list of Professor Trail's publications is appended to the notice.

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# TRANSACTIONS 1919

Edited by

CARLETON REA and J. RAMSBOTTOM

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## THE PAINSWICK FORAY.

*21st–25th May*, 1920.

For the first time since 1915 it was found practicable this year to hold a Spring Foray. This took place during the Whitsun holidays, May 21st to 25th, at Painswick, Gloucestershire, the headquarters being at the Falcon Hotel, Painswick, where a large, well-lighted room was secured for the exhibition of specimens.

Some twenty-five members and friends attended, and a most enjoyable week-end was spent, favoured by glorious weather. From the mycological point of view the Foray was disappointing, owing to the dry weather, which is fatal to fungus growth in these hilly districts. Although fungi were scarce, however, there was a wide field in other directions, and as the party included lichenologists, bryologists and conchologists, as well as phanerogamic botanists, there was plenty of varied interest.

Larger fungi were of course very few. The most outstanding species was *Sarcosphaera coronaria*, which was fairly common in all the beech woods, and of which some very large specimens were gathered. On the Sunday at Sheepscombe several of the party collected *Aleuria umbrina*, a rather unusual Discomycete, and at Birdlip Mr Pearson secured a single specimen of *Acetabula vulgaris*. *Trametes suaveolens* was found by Mr Rea at Sheepscombe.

Of the microfungi perhaps the most interesting was *Chrysomyxa Pyrolae*, found in two localities. *Dichaena faginea* was abundant on the beeches, but only in the conidial stage.

In Pope's Wood Mr Grinling came across a single specimen of *Eichleriella spinulosa*. This is the first time it has been collected in the South—the only previous collections known to me being from Forres, Glamis, and Mulgrave Woods. This is an interesting plant, which has had a varied history as regards its nomenclature. Bresadola, who first noted its large septate basidia, placed it in a new genus *Eichleriella*, calling it *E. Kmetii*. Then it was found that English records of *Stereum rufum* were based on this plant, and further that *Radulum deglubens* B. & Br. was the same species, so the name became *E. deglubens*. Now Burt has shown that *Radulum spinulosum* B. & C. is also the same, and as this is a still earlier specific name the combination *E. spinulosa* Burt must stand. It is to be hoped no one will find yet an earlier name than this.

On the Saturday evening a short meeting was held, at which the Secretary read on behalf of Mr A. D. Cotton, who was unable to be present, some notes on "Black Rust on Wheat."

In view of the serious outbreak of this disease in South-West Wales (Pembrokeshire, Cardiganshire, and Carmarthenshire), Mr Cotton appealed to members of the Society to assist in collecting data as to the incidence of rust fungi on cereals in the western counties, and particularly in Devon and Cornwall.

At the request of the Essex Field Club a resolution was passed deploring the attempt being made to infringe the Epping Forest rights by making the war-time allotments permanent, but a rider was added that alternative arrangements should be made to safeguard the interests of allotment-holders. The Secretary of the Essex Field Club has since written that further action is at present unnecessary, as the Conservators are taking action to safeguard the Forest rights.

Mr Pearson announced that Dr Paul had very kindly marked in his copy of Cooke's "Catalogue of British Basidiomycetes" the correct accentuation of fungus names, and that this list was at the disposal of any member who was interested. A cordial vote of thanks to Dr Paul for his trouble was carried by acclamation.

During the Foray Mr Hadden exhibited the following from West Porlock: *Puccinia Umbilici, P. variabilis, Uromyces sparsus, Exoascus Pruni, Mitrula phalloides, Arachnopeziza aurelia,* and *Elaphomyces granulatus.* Miss Collins showed the rare subterranean fungus, *Melanogaster ambiguus*, which was dug up at Clapham, near Worthing.

For assistance in compiling the subjoined list the Secretary is indebted to Mr Carleton Rea and Mr A. A. Pearson. The Mycetozoa were worked out by Dr W. T Elliott and Mr N. G. Hadden, who forwarded the list appended.

## COMPLETE LIST OF FUNGI GATHERED DURING THE FORAY.

*B.* = Birdlip; *C.* = Cranham; *S.* = Sheepscombe. Where not otherwise indicated the species was found in the near neighbourhood of Painswick.

Tricholoma terreum (Schaeff.) Fr., gambosum Fr., *Dursley*, personatum Fr., *S.*, melaleucum (Pers.) Fr., var. polioleucum Fr.

Collybia esculenta (Wulf.) Fr., *S.*, dryophila (Bull.) Fr.

Clitocybe rivulosa (Pers.) Fr., *S.*

Pluteus cervinus (Schaeff.) Fr., *B.*, nanus (Pers.) Fr., var. lutescens Fr., *C.*

Pholiota mutabilis (Schaeff.) Fr., *B.*, marginata (Batsch) Fr., *B.*

Tubaria furfuracea (Pers.) W. G. Sm.

Stropharia semiglobata (Batsch) Fr.
Hypholoma fasciculare (Huds.) Fr.
Psathyra corrugis (Pers.) Fr., *S.*
Coprinus niveus (Pers.) Fr., micaceus (Bull.) Fr., radiatus Fr., *B.*
Panaeolus sphinctrinus Fr., campanulatus (Linn.) Fr.
Psathyrella disseminata (Pers.) Fr.
Boletus elegans (Schum.) Fr., badius Fr., laricinus Berk.
Polyporus adustus (Willd.) Fr., *B.*
Fomes annosus Fr., *B.*
Polystictus versicolor (Linn.) Fr.
Trametes gibbosa (Pers.) Fr., suaveolens Fr., *S.*, rubescens (A. & S.) Fr., mollis (Somm.) Fr.
Hydnum udum Fr.
Irpex obliquus (Schrad.) Fr.
Odontia fimbriata (Pers.) Fr., farinacea (Pers.) Quél.
Corticium laeve (Pers.) Fr., Sambuci (Pers.) Fr., botryosum Bres., subcoronatum von Hoehn. & Litsch., confine Bourd. & Galz., sulphureum (Pers.) Bres., praetermissum (Karst.) Bres.
Peniophora longispora (Pat.) von Hoehn. & Litsch., velutina (DC.) Cooke, cremea Bres., cinerea (Fr.) Cooke, hydnoides Cooke & Mass.
Auricularia auricula-Judae (Linn.) Schroet.
Dacryomyces deliquescens (Bull.) Duby.
Calocera cornea (Batsch) Fr.
Eichleriella spinulosa (B. & C.) Burt.
Uromyces Scillarum (Grev.) Wint.
Puccinia Violae (Schum.) DC., Aegopodii (Schum.) Mart., fusca (Relh.) Wint., Heraclei Grev., *S.*, Saniculae Grev., *S.*, obtegens (Link) Tul., Hieracii (Schum.) Mart., *S.*, Hypochaeridis Oud., Chondrillae Corda on *Lactuca muralis*, Lampsanae (Schultz.) Fuck., variabilis Grev., *S.*, Vincae (DC.) Berk., Betonicae (A. & S.) DC., Caricis (Schum.) Rebent., on *Urtica*, Poarum Niels., on *Tussilago*, *S.*
Phragmidium Sanguisorbae (DC.) Schroet., *B.*
Coleosporium Senecionis (Pers.) Fr., on *Pinus*.
Ochropsora Sorbi (Oud.) Diet. (=Aecidium leucospermum DC.), *S.*
Endophyllum Euphorbiae-silvaticae (DC.) Wint., *S.*
Chrysomyxa Pyrolae (DC.) Rostr., *C.*, *S.*
Melampsora Rostrupii Wagn., on *Mercurialis perennis*, *B.*
Melampsorella Symphyti (DC.) Bubak.
Urocystis Anemones (Pers.) Wint., *B.*
Cystopus candidus (Pers.) de Bary, cubicus (Strauss) de Bary, *B.*
Peronospora calotheca de Bary, on *Asperula odorata*, Ficariae Tul, *S.*
Plasmopara nivea (Ung.) Schroet., on *Anthriscus*, *S.*

Pilobolus crystallinus (Wigg.) Tode.
Protomyces macrosporus Ung.
Sphaerotheca pannosa (Wallr.) Lév.
Microsphaera Alni (DC.) Wint., on *Rhamnus catharticus.*
Erysiphe graminis (DC.) Fr.
Hypomyces aurantius (Pers.) Fuck., on *Polystictus versicolor.*
Chaetomium elatum Kunze.
Rosellinia aquila (Fr.) de Not.
Diatrype Stigma (Hoffm.) de Not., disciformis (Hoffm.) Fr.
Hypoxylon fuscum (Pers.) Fr., coccineum (Bull.) Fuck., rubiginosum (Pers.) Fr.
Ustulina vulgaris Tul.
Xylaria polymorpha (Pers.) Grev., Hypoxylon (Linn.) Grev.
Rhytisma acerinum (Pers.) Fr.
Dichaena faginea (Pers.) Fr.
Acetabula vulgaris Fuck., *B.*
Aleuria umbrina Boud., *S.*
Sarcosphaera coronaria (Jacq.) Boud.
Cheilymenia stercorea (Pers.) Boud.
Coprobia granulata (Bull.) Boud.
Ascobolus stercorarius (Bull.) Schroet.
Ascophanus ochraceus (Cr.) Boud.
Polydesmia pruinosa (B. et Br.) Boud., on *Diatrype Stigma.*
Hyalinia inflatula (Karst.) Boud.
Dasyscypha virginea (Batsch) Fuck., bicolor (Bull.) Fuck., cerina (Pers.) Fuck.
Trichoscypha calycina (Schum.) Boud.
Hyaloscypha hyalina (Pers.) Boud.
Mollisia cinerea (Batsch) Karst.
Pseudopeziza Trifolii (Biv.-Bern) Fuck.
Ovularia obliqua (Cooke) Oud., on *Rumex.*

MYCETOZOA.

Ceratiomyxa fruticulosa (Muell.) Macbr., *B.*
Physarum nutans Pers., *B.*, *C.*
Craterium minutum (Leers) Fr., *B.*
Diderma spumarioides Fr., *B.*
Didymium difforme (Pers.) Duby., *S.*
D. squamulosum (Alb. & Schw.) Fr., *B.*
Stemonitis fusca Roth.
Enteridium olivaceum Ehrenb.
Reticularia Lycoperdon Bull.
Lycogala epidendrum (L.) Fr., *C.*, *S.*
Trichia persimilis Karst., *B.*
T. decipiens (Pers.) Macbr., *B.*
Arcyria denudata (L.) Sheldon, *B.*

# LICHENS FOUND NEAR PAINSWICK.

*22nd–25th May*, 1920.

*By Robert Paulson, F.L.S., F.R.M.S.*

In so short a period as three days it was only possible to search over a very circumscribed area of the higher ground to the north-west of Painswick. A few species were, however, seen upon the larger trees, beech and ash, in the woods near Birdlip.

A noticeable feature of the lichen flora of this district is the paucity of corticolous and terricolous species. Those that were gathered proved to be very poorly developed specimens belonging to the Pertusariaceae, Cladoniaceae and Graphidiaceae. This feature cannot be explained by saying that it is simply due to the low light-intensity within the wood, for shade lichens of the Graphidiaceae are equally rare and stunted in growth as are those belonging to the Parmeliaceae. On the outer borders of the woods, towards the south and south-west, where the light-intensity is considerably higher than it is some distance within the wood, corticolous lichens rarely occur.

This area is not adversely affected by a great smoke drift, for the trunks and branches of the trees are not begrimed with soot as they would be if subjected to such a baneful influence.

The only suggestion that can at present be offered to explain the absence of the corticolous species in the woods around Painswick, is, that such absence may be due to some edaphic factor of the soil which is as yet unknown to us, for it is highly probable that edaphic factors are occasionally inimical to lichen growth within a wood.

There is a comparatively rich harvest of saxicolous species, shown by the accompanying list, to be gathered on the sunny side of the field oolitic-stone walls and from the rocks projecting through the soil, when these are sufficiently remote from the clouds of dust that are raised by the heavy motor traffic upon the main roads. The species of the walls are for the most part crustose; there are very few foliose species upon them.

*Tichothecium pygmaeum* Koerb., a fungus parasite, was abundant on the thallus of *Placodium rupestre*.

## LIST.

w., on walls; r., rocks; t., on trees; s., on soil; f., fertile.

*Placynthium nigrum* S. F. Gray, w., f.
*Parmelia physodes* Ach., very poorly developed, t.
*P. caperata* Ach., t., *P. sulcata* Ach., t.
*P. dubia* Schaer., t., *P. fuliginosa*, var. *laetevirens* Nyl., t.
*Evernia prunastri* Ach., t., *Xanthoria parietina* Th. Fr., w., f.
*Placodium callopismum* Mér., w., f., *P. murorum* DC., w., f.
*P. variabile* Nyl., w., f., *P. rupestre* Branth & Rostr., w., f., and var. *calvum* A. L. Sm., w., f., *Physcia pulverulenta* Nyl., t., f.
*P. hispida* Tuckerm., t., r., *Lecanora subfusca*, var. *chlarona* Ach., t., f., *L. allophana* Ach., t., f.
*L. campestris* B. de Lesd., w., f., *L. galactina* Ach., w., f.
*L. conizaea* Nyl., t., f., *L. calcarea* Sommerf., w., f.
*Pertusaria faginea* Leight., t.
*P. pertusa* Dalla Torre & Sarnth., t., *P. leioplaca* Schaer., t., f.
*Cladonia furcata* Schrad., s., and var. *spinosa* Leight., s.
*Gyalecta exanthematica* Fr., r., f.
*Lecidea Metzleri* Th. Fr., w., f., *L. parasema* Ach. t., f.
*Biatorella pruinosa* Mudd, r., f., *Biatorina lenticularis* Koerb., w., f.
*Bilimbia sabuletorum* Branth & Rostr., moss, w., f.
*B. aromatica* Jatta, w., f.
*Buellia myriocarpa* Mudd, on yew trees in the church-yard, f.
*Rhizocarpon alboatrum* Th. Fr., var. *epipolia* A. L. Sm., w., f.
*Arthonia radiata* Ach., var. *Swartziana* Sydow., t., f.
*Opegrapha Leightonii* Cromb., w., f.
*Dermatocarpon hepaticum* Th. Fr., s., f.
*Verrucaria rupestris* Schrad., w., f.
*Thelidium immersum* Mudd, w., f., *T. incavatum* Mudd, w., f.
*Acrocordia gemmata* Koerb., t., f., *A. epipolaea* A. L. Sm , w., f.

# PRESIDENTIAL ADDRESS.

*By Harold Wager, D.Sc., F.R.S., F.L.S.*

On this the first annual meeting of the Society since its reorganisation, it is appropriate that I should devote a few minutes of the time at my disposal to consider briefly the progress made in Mycology during the time the Society has been in existence, a period covering nearly a quarter of a century.

During this period our knowledge of the life-histories of the Fungi, especially the Phycomycetes, Ascomycetes, and Basidiomycetes (Uredineae and Hymenomycetes) has been completely revolutionised. The perfection of the microscope, and the introduction of more refined methods of investigation, have enabled us to elucidate the cell structure or cytology of the Fungi to such a degree of completeness that in this respect they are almost as well known as the more highly developed plants.

In Physiology, Pathology and in the biological relationships of parasitic forms to their hosts very important contributions, of interest, not only to the mycologist and biologist, but to investigators in various other branches of science, have been made. The progress which has taken place in our knowledge of fertilisation in the Fungi, and the discovery of endokaryogamy, a process of nuclear fusion entirely unknown before either in plant or animals, have led to various new conceptions of the significance of sex and nuclear fusions.

Many new systems of classification have been proposed, and some of them have been very favourably received, but in this country the system devised by Fries is, for all practical purposes, still maintained. The difficulties which are confronted in the attempt to devise a more natural classification are very great. Although much has been done to elucidate the life-histories of the Fungi, we are still unacquainted with the complete life-histories of the vast majority of the Fungi, and the list of Fungi Imperfecti—Fungi which are supposed to be stages in the life-histories of other Fungi—is still so vast that anything like a reasonably natural classification is out of the question. Something however might be done to introduce a more natural arrangement of the British Fungi than that at present in use. Probably the most serviceable classification available is that given by Engler and Gilg in the Syllabus der Pflanzenfamilien.

This is based upon the fuller classifications in Engler and Prantl's Pflanzenfamilien and although it leaves much to be desired, especially in the classification of the Basidiomycetes, may be very well taken as a basis for further improvements and emendations.

The study of ecological problems arising out of the distribution of the Fungi is almost an untouched field. Many of these problems are most difficult and perplexing, and will demand most patient and laborious investigation both in the field and in the laboratory. We may hope that the committee appointed by the British Association to report upon the possibilities of the investigation of the ecology of the Fungi may very shortly indicate profitable lines of study along which our energies may be directed.

The British Mycological Society has played an important part in the progress of Mycology during the period under review; many of the most striking discoveries made during the last twenty-five years, which have completely modified our views and conceptions of Mycology, have been made by members of our Society. Our most grateful thanks are due to Mr Carleton Rea, and, may I add, to Mrs Rea also, for the splendid services they have rendered during all these years in the organisation and development of the work of the Society. Not the least important effect of the success of the Society has been the possibility of its reconstitution upon a wider basis, and with a more elaborate organisation. We look forward with confidence to a highly successful and prosperous future for the Society, and to increased activity and usefulness in all departments of Mycology in which we hope that both amateur and professional mycologists will play their part.

Before I pass on to the main subject of my address I wish to refer briefly to the losses we have sustained by death during the year.

The death of Thomas Gibbs, who had been a member of our Society from its foundation, leaves us the poorer by a charming personality, and an indefatigable worker in the realm of systematic mycology. Although leading the busy life of a professional man he found time to contribute to various scientific journals no less than forty papers on Natural History topics of which rather more than half are on Fungi.

By the death of Sir Charles Thomas Dyke Acland, Bart., who joined the Society in 1899, we have lost a member who always took a friendly and sympathetic interest in our work.

Two promising young mycologists died during the last year, Dr Arthur Eckley Lechmere and Mr Charles Ogilvie Farquharson; the former would have been a member of our Society had not

the great European War prevented it, and I am quite sure therefore that you would wish me to mention them here.

The tragic death of Dr Arthur Eckley Lechmere, on February 14th of this year, which occurred soon after his return to England after a period of four years as a prisoner of war in Ruhleben, deprives mycological science of an unusually gifted and versatile investigator. The story of his life at Ruhleben and of his setting up under most difficult and primitive conditions, of a well-equipped biological laboratory, in which teaching and research were carried on, savours of the romantic and will not easily be forgotten. By his unflagging industry and enthusiasm he aroused a genuine interest in natural science which not only alleviated the rigours of the prison camp, but gave to many an impetus to scientific study. Surely such a piece of work will take its place among the honourable records of distinguished service rendered during the war.

Mr Charles Ogilvie Farquharson whose untimely death occurred through the collision at sea of the homeward bound SS. Burutu on October 3rd 1918, was a promising tropical mycologist whose work had already shown distinction and originality.

By the death of Mr Anthony Wallis we have lost a mycologist of high attainments and ability. As a member of the Yorkshire Mycological Committee he had done excellent service to Mycology, and he was also engaged in a special study of the Fungi of Cumberland. Had he lived he would have been proposed as a member of our Society at this meeting.

## THE SIGNIFICANCE OF SEX AND NUCLEAR FUSIONS IN THE FUNGI.

In his Presidential Address at the first annual meeting of the Society at Worksop in 1897 Mr George Massee gave some account of mycological progress during the sixty years from 1837 to 1897, a period within which practically all the knowledge we possessed of Fungi as living organisms had been acquired.

The very considerable progress made however, during the last decade of that period, in our knowledge of the sexuality and reproduction of the Fungi was only slightly touched upon by Massee, and it has seemed to me, therefore, that a brief discussion of some of the aspects of the problems of sex and nuclear fusions in the Fungi which have come to light during the last thirty years might usefully occupy the time that remains to me.

In one of his interesting essays on "Problems of Life and Reproduction" my friend Professor Hartog has taken me to task for the use of the word sexuality in connection with the

Fungi where "no differentiation of male or female exists in some of the most important and, indeed, primitive types." As Professor Hartog points out the term sex "originally implied a binary differentiation of pairing cells into categories of distinct size and habit." But the more we know of the physiology of sex the more we see that this difference in size and habit is only a morphological indication of profound internal differences. Such differences may exist in fusing cells which are morphologically identical, and there is no good reason why they should not be regarded as sexual. Among the Mucors for example, as Blakeslee has shown, isogamy is only morphological. "Sexually the two (morphologically identical) gametes which unite have diametrically opposite characters."

The idea of sex may be thus extended, and quite justifiably so, I think, to cell fusions which take place between cells of the same size if they result in the production of a zygote, and are characterised by similar phenomena to that of binary fusions. Such cells although not morphologically heterogamous are physiologically heterogamous, and the difference between male and female is thus at bottom a physiological one and not morphological.

Sexual fusion or fertilisation involves not only the fusion of two cells, but also the fusion of their nuclei. This latter fact was not definitely established until 1875 when O. Hertwig and Hermann Fol independently discovered the fusion of the egg nucleus with the sperm nucleus in the egg of the sea urchin. These observations were soon confirmed and extended both in animals and plants, but it was not until 1889 that any satisfactory indication of the fusion of a male with a female nucleus was observed in the Fungi, and it was not until 1896 that it was definitely established.

At that time the existence of sexual organs in the Fungi was well known. Oogonia and antheridia had been seen in many forms of the Peronosporeae, and the formation of zygospores by the fusion of two equivalent cells, or two unequal cells had been definitely observed in the Mucorineae. There were indications of sexuality in the Ascomycetes, and already it had been surmised that the aecidium of the Uredineae might be the seat of sexual organs. The passage of the protoplasm of a male cell into a female cell had been clearly observed in *Pythium de Baryanum* by Marshall Ward and de Bary. No fusion of nuclei had however been seen. This is not surprising for at that date it was not known whether the majority of the Fungi possessed true nuclei. Strasburger (1884) had observed the presence of true nuclei in *Trichia fallax* but, except for some deeply stainable granules which had been seen in various species of Fungi,

and which, simply on account of their staining properties, were regarded as nuclei, the presence of true nuclei in the majority of Fungi had not been established.

De Bary remarks for example (1887, Comparative Morphology and Biology of the Fungi, etc.), "The satisfactory discrimination of true nuclei from other small bodies contained in the protoplasm, and like them perhaps rendered more distinct by colouring reagents, is extremely difficult, and can only be obtained after renewed investigation." The determination of the nuclear nature of these granules depends not on their stainable properties, but upon their structure and mode of division. Where this is accompanied by mitosis the nuclear nature of any given body is unmistakable.

Evidence of mitotic nuclear division had been obtained in 1883 by Sadebeck in Asci of *Exoascus*, by Strasburger in 1884 in *Trichia fallax*, by Fisch in 1885 in Ascomycetes, and by Eidam in 1887 in *Basidiobolus*.

In 1889 I described the nuclei of *Peronospora parasitica* and showed that they possessed a normal nuclear structure, nuclear membrane, nuclear net-work and nucleolus, and further that the process of division was karyokinetic in that chromosomes were formed, a nuclear spindle produced, and the separation of the chromosomes along the spindle to form two daughter nuclei. The nuclei of *Peronospora parasitica* in fact differ in no essential particular from the nuclei of higher plants and animals.

Hartog in 1889 and 1895 saw some mitotic stages in *Saprolegnia*, Rosen in 1892 thought he had obtained some indications of nuclear division in Basidiomycetes, but he mistook stages of the resting nucleus for these, Gjurasin in 1893 described mitosis in the nucleus of the ascus in *Peziza vesiculosa*, Lister in 1893 mitosis in Mycetozoa, Wager in 1891–4 mitosis in Basidiomycetes, in which spindle figure, equatorial plate and centrosomes were seen, and Harper in 1895 obtained beautiful figures of mitosis in asci.

Since then our knowledge of the nuclei of Fungi has been extended to all the groups of Fungi, and we know that the nuclei of the Fungi do not differ in any essential feature from the nuclei of higher plants and animals.

Side by side with our knowledge of their nuclei our knowledge of the sexual phenomena in the Fungi has been developed and the importance of the nuclei in the process has been demonstrated.

All that we know definitely of the behaviour of the nuclei in the formation of the sexual organs and in the subsequent fertilisation which takes place has been discovered during the last thirty years, but all the essential features of this fertilisation were

definitely established in the first ten years of this period, that is between 1889 and 1900.

Thus in 1889 the chief stages of nuclear behaviour in the maturation of the zygote of *Peronospora* were described. It was shown that the oogonium contained over 100 nuclei, each of which divided at least once, so that the oogonium contained some 200 nuclei or more, that the fully formed oosphere contained only one nucleus, that a branching tube from the antheridium carrying one nucleus penetrated the oosphere, that subsequently an empty antheridial tube was seen, that the oosphere then was found to contain two nuclei presumably male and female, and that at a later stage only one nucleus was visible. The conclusion was arrived at therefore that a male nucleus passes over from the antheridial tube into the oosphere, and finally fuses with the central nucleus. That this is what actually takes place was definitely proved in 1896 for *Cystopus candidus*, and in 1900 for *Peronospora parasitica*, and has been abundantly confirmed by many observers. Here, then, we have a definite sexuality, viz. the fusion of morphologically differentiated male and female organs. The female organ is a large egg cell, containing abundance of cytoplasm, the male organ is a smaller cell containing several nuclei and protoplasm, but only one of the nuclei, with probably no cytoplasm, or only a very minute quantity, migrates from the male organ into the egg cell. Morphologically then this sexual fusion differs in no essential respect from what takes place in higher plants and animals. But this well-marked sexuality is not maintained throughout the other groups of Fungi, and subsequent investigations show that profound modifications of the sexual process occur. The first indication of this was discovered in 1891 (Report of the British Association, 1891) in the Hymenomycetes, in which no sexual differentiation had so far been observed. It was found that two nuclei were present in the young basidium, and that these two nuclei fused together before the formation of the basidiospores. The structure of the nuclei was found to be similar to that of the nuclei in the higher plants: each "consists of a nuclear membrane enclosing a dense nucleolus and a thread-like network." In a later paper, 1893, the fusion of the nuclei was described in detail, and the subsequent division of the fusion nucleus was also described; a spindle figure, chromosomes and centrosomes were observed, and the extrusion of the nucleolus into the cytoplasm. The number of chromosomes could not be determined exactly, but all the figures published show eight or ten chromosomes in the division of the fusion nucleus, and four or five in the daughter nuclei. In later papers it was shown that the number of chromosomes in the vegetative nuclei was four, in

the fusion nucleus eight, and that the result of the reducing division was the separation of these eight chromosomes into two groups of four each for the two daughter nuclei. Maire's statement that the vegetative nuclei contain only two chromosomes, and the fusion nucleus four, is quite incorrect.

My original investigations gave some indications of the fusion of three or four nuclei in the basidium, and Maire also stated that he had found three or four nuclei in young basidia, but the subsequent researches of Harper, Dangeard, Maire and myself showed quite clearly that this was abnormal and that the basidium normally contains two nuclei only.

Concerning this discovery of two nuclei in the basidium, and their subsequent fusion, Professor Harper remarks: "The most striking discovery as to fusion in the fungi and the one which preceded and led the way to very many of the most important later results was the observation by Wager of paired nuclei and the subsequent fusion of these nuclei in the young basidium." This was "the first proof of the existence of an endokaryogamy —the fusion of nuclei not derived from separate and independent gametes as in ordinary fertilisations, but having had a similar if not identical history in the cells from which the basidium arose. Such a process was entirely unknown before in either plants or animals (American Naturalist, Sept. 1910).

Subsequently in 1893 (Comptes rendus, Acad. des. Sc. Feb. 1893) Dangeard and Sappin-Trouffy announced the discovery of a binucleate condition in the aecidiospores and teleutospores of the Uredineae, and in Le Botaniste (ser. IV. 1894–5) Dangeard announced the discovery of two nuclei in the ascus, and their fusion. Dangeard regards the fusion of nuclei in the basidium, ascus and teleutospore as sexual in the ordinary sense of the term, the nuclei which fuse being equivalent to gametes, and the resulting uninucleate cell in each case as equivalent to an oospore or egg. Harper's observations on the true sexual organs of the Ascomycetes, and the discovery of binucleate cells in the vegetative stages of the Basidiomycetes and the cell fusion discovered by Blackman at the base of the aecidium in the Uredineae all tend to show however that the problem of the sexuality of the higher Fungi is an extremely difficult one to solve.

Whatever sexuality may be intrinsically, whatever may be its function physiologically or in heredity, it is essentially characterised by the association of two cells, each with its nucleus, and their fusion to form a zygote. The production of this zygote or egg takes place at a definite period in the life-history of any plant or animal in which it occurs, marking the close of a definite cycle in the life-history, and the beginning of another. Within this egg are contained all the essential charac-

teristics of the organisms from which it is derived, and from it a new individual arises. From the fact that, in the higher animals, this fusion of cells and nuclei is always necessary before any reproduction can take place, the sexual fusion was regarded as an act of reproduction.

But fertilisation is not an essential factor in reproduction. It has been shown that eggs which under normal conditions are fertilised can also develop without fertilisation if the male gamete is replaced by some other agent capable of effecting the necessary stimulation. Already in 1785, long before the morphological characteristics of fertilisation had been established, Spallanzani had tried to make use of such agents as electricity, extracts of various organs of the body, dilute acids, alcohol, etc., to stimulate the development of the egg in place of the seminal fluid. His experiments were however unsuccessful, but in recent studies of fertilisation on some of the lower forms of life it has been found possible to induce at least the earlier stages of development of the egg by other agents than that of the male organ, and it is now well known that fertilisation may be in certain cases replaced by stimuli of various kinds.

Tichomiroff (1886) found that the unfertilised ova of the silk moth could be stimulated to develop by rubbing them with a brush, or dipping them for two minutes in sulphuric acid and then washing them, and Loeb especially has given us since 1892 numerous examples of substances, hypertonic sea-water, solutions of magnesium chloride, sugar, potassium salts, inorganic acids, calcium salts, fatty acids, etc.—all of which are capable of effecting division in non-fertilised eggs.

In the conjugation of one of the Protozoa—*Paramoecium*—which has been very carefully studied by numerous observers it has been found that although under normal conditions rejuvenescence is brought about only after conjugation, it has been found that rejuvenescence may be brought about by changes in the culture fluids (Calkins), or may even be brought about spontaneously, without conjugation (Woodruff).

The observations of Woodruff are extremely interesting from the point of view of the Fungi. He showed (1914, Jour. Exp. Zool.) that the explanation of this spontaneous rejuvenation without conjugation in *Paramoecium aurelia* is due to a nuclear reorganisation in the individual cells which may be compared to the nuclear reorganisation which takes place in conjugation. The macronucleus breaks up and disappears, the micronuclei divide twice, but the third division, which normally occurs in conjugation, does not take place, a new macronucleus being formed from the micronuclei, with ultimately a restoration of the normal nuclear organisation. We have thus a nuclear re-

organisation which takes place, in the absence of fertilisation, at regular periods, and is sufficient for the continual development of the organisms.

These observations clearly indicate therefore that, although nuclear fusion is necessary for the blending of hereditary characters, it is not essential for growth and development, since the developmental stimulus under certain conditions can be effected by other agencies.

The observations which have recently been made on the binucleate cells in the vegetative tissues of the higher plants by Prankerd (Ann. Bot. 1915), and Beer and Arber (Ann. Bot. 1915; Proc. R. Soc. 1919), have an important bearing on the rejuvenation function of sexual and other nuclear fusions. It appears that multinuclear cells are very widely distributed and that they are characteristic of young tissues which are actively carrying on the processes of life. Most frequently the cells are binucleate, but three, four or even more may occur, and the paired nuclei often become surrounded by a differentiated shell of cytoplasm, "phragmosphere," which gradually expands until it merges in the peripheral cytoplasm. Professor R. C. McLean considers that there is also evidence of nuclear fusions taking place in these cells. The multinucleate stage reaches its most characteristic expression just previous to the maximum period of growth, when metabolic activity is running high. There appears to be in fact a definite cytoplasmic and nuclear reorganisation in the cells of young tissues just at a time when vigorous growth and development are taking place, and this may "conceivably afford the organism a distinct advantage in carrying out the chemical processes associated with growth, and might tend to become perpetuated as a definite physiological phase in the history of growing members."

A normal sexual fusion includes at least two distinct phenomena, (1) the blending of the parental characters derived from two distinct lines of descent, and (2) rejuvenescence of the reproductive cell by means of which it receives a new stimulus to growth and division. This exogamic binary sexual fusion is found at the present day, so far as we know, in a few fungi only, although formerly it may have been of more frequent occurrence. In the majority of fungi in which binary sexual fusion occurs (*e.g.* fusion of differentiated gametes) this fusion is endogamous (*e.g.* the gametes are produced on the same individual). Here it is obvious that, since there can be no blending of two lines of descent, the only purpose of this sexual fusion is rejuvenescence.

The production of distinct male and female organs on the bisexual thalli of such forms as Cystopus and Peronospora indi-

cates, however, that a definite physiological differentiation takes place at the time the sexual organs are formed. We do not know what this differentiation may be. It is not necessarily associated with a difference in the amount of food present in the respective male and female organs, for the same physiological differentiation obtains, as Blakeslee has shown, in the bisexual morphologically isogamous mucors. We may perhaps conceive it as something of the nature of a chemical difference in the nuclei brought about by their reactions to cytoplasmic influence, or possibly to some differentiation or segregation of hereditary factors. In the subsequent fusion of the male and female nuclei in the zygote, we have therefore no blending of two lines of descent but simply a recombination of nuclei which had become more or less differentiated in the individual. This recombination restores the vigour necessary for further development, and is sufficient to enable the fungus to continue its development by a prolonged period of vegetative reproduction during which vast numbers of asexual spores are formed without any further nuclear fusion, until the stage is reached when reinvigoration again becomes necessary and sexual organs are once more formed.

In the higher Fungi this normal type of sexual nuclear fusion has disappeared or is disappearing and is being replaced by a simpler type of nuclear fusion — endokaryogamy — the purpose of which is to provide for the nuclear reorganisation and reinvigoration of the individual reproductive cells just at the time when large numbers of spores are about to be formed.

In the Hymenomycetes and Uredineae this appears to be the only type of nuclear fusion that remains. The basidium of the Hymenomycetes, with its two nuclei, is the last term in a long series of binucleated cells which appears to extend back to a period prior to the formation of the carpophore. How this binucleate condition comes about we do not know, although suggestions have been made that it may arise as the result of fusions taking place between the cells of the primary mycelium by which plasmogamy is effected and cells with two nuclei are produced. It has also been stated that the binucleate condition is brought about by means of the clamp connections, but this requires confirmation. On the evidence at present available the most satisfactory explanation is that the binucleate condition occurs simply by differentiation during the formation of the cells of the primary mycelium which, at the beginning of their development, may contain from one to many nuclei.

In the Uredineae the origin of the binucleate cells has been more clearly determined. In those forms which possess an

aecidium it takes place in the cells at the base of the young aecidium. Maire described in some species a re-duplication of the nuclei by the division of the single nucleus of uninucleate terminal cells of hyphae below the aecidia. But this has not been confirmed and is, no doubt, from the evidence afforded by more recent observations, incorrect. Blackman found that cells become binucleate by the migration of a nucleus from one cell to another, and Christman showed that it might also be effected by the fusion of two cells. In the absence of an aecidial stage cell fusion may take place in the vegetative cells at the base of the uredospores or teleutospores. In *Uromyces Scillarum* (Grev.) Madame Moreau believes it may take place somewhere in the vegetative mycelium.

The cellular fusion at the base of the aecidium probably takes the place of an ancestral fusion of normal sexually differentiated gametes. Blackman suggests that this may be characterised as a vegetative fertilisation. After a more or less prolonged period of vegetative growth, during which the cells maintain their binucleate condition, large numbers of teleutospores are formed, each of which receives two nuclei; these ultimately fuse, and this is held to be the final stage in a sexual fusion which began by the fusion of cells in the aecidium. But this does not seem to me to be a satisfactory explanation of what takes place. The binucleate condition of the vegetative cells is a necessary preliminary to endokaryogamy in the teleutospore, but the result would be the same in whatever way the cells might become binucleate. We may regard the fusion of the cells in the aecidium as the result of a degraded or vegetative sexual differentiation, or simply as the fusion of somatic cells, taking the place of the original fusion of sexually differentiated gametes. It is not necessarily connected with the original sexual act, but may be a new type of cell fusion brought about in order to provide the binucleate condition of the vegetative cells necessary for endokaryogamy. The significant phenomena in this new type of fusion are the nuclear fusion and the subsequent reducing division in the teleutospore which provide just that new cytoplasmic and nuclear association upon which the stimulus necessary for the rejuvenescence and continued development of the organism depends.

In the Ascomycetes we have perhaps the clearest indication that a normal sexual fusion is being replaced by endokaryogamy. In some forms there are well-developed sexual organs, and, if Harper's observations are correct, a normal sexual fusion of nuclei, comparable in all respects with the sexual nuclear fusions in the lower Fungi. Others possess well-developed sexual

organs which are no longer functional, and in many forms the sexual organs show various stages of degeneration or have disappeared entirely. But whether sexual organs are formed or not there is always a nuclear fusion in the ascus.

Thus in the higher forms of the Ascomycetes there may be two distinct stages in the life cycle, the formation of well differentiated sexual organs, and, separated from these by a more or less numerous series of intermediate cell divisions, the formation of asci. On the evidence before us therefore the nuclear reorganisation which takes place in the ascus may have nothing whatever to do with fertilisation, but may be simply a means by which the vigour of the cell is restored just at the period when it is probably impaired and when renewed vitality is required for the formation of the reproductive elements.

The problem now arises: how is this phenomenon of endokaryogamy to be regarded in relation to a normal sexual act? Whatever may have been the original purpose or function of fertilisation it is clear that a normal fertilisation includes the blending of two lines of descent, and the restoration of vigour to cells which have become senescent. Hartog defines senescence as "the diminution of all vigour in life, nutrition, growth, and, above all, reproductive power" (Problems of Reproduction, p. 22), and he has given a most interesting explanation of the probable causes of senescence. The nucleus is the centre of the cell, governs its life and responds to the stimulus of the cytoplasm. We may well conceive, says he, that "the nucleus during the continuance of active cellular life gradually loses its readiness of response to the stimulation from the cytoplasm, and with its sensibility the power to guide and control aright the functions of the cytoplasm; so that the life of the cell is impaired." An internal reorganisation of the cell would restore the sensibility of the nucleus and the stimulatory activity of the cytoplasm, and this could be effected by fertilisation. But if the primary function of fertilisation or syngamy in its widest sense is merely rejuvenescence, and if, in any given form, this function is the only one effected by the sexual act, then it is clear that the complex sexual differentiation necessary for the blending of two lines of descent would no longer be required, since a complete cellular reorganisation can be effected in a much simpler way, by the fusion of cells and nuclei related by the closest bonds of cellular kinship.

It is therefore reasonable to conclude that if the blending of two lines of descent has become, for some reason or other, superfluous, the mere reinvigoration of the reproductive cell or cells may be effected by a much simpler type of nuclear reorganisa-

tion than that required for amphimixis. It is not improbable, therefore, that this affords a sufficient explanation, on the evidence available, of what is taking place in the higher Fungi where the endokaryogamy, a simple type of nuclear fusion which seems to be concerned solely with rejuvenescence, is apparently taking the place of a more complex process of binary sexual fusion.

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## RECORDS OF SURREY RESUPINATE HYMENOMYCETES.

*By E. M. Wakefield, F.L.S. and A. A. Pearson, F.L.S.*

The species in the third list we bring forward were for the most part collected within the same area as those recorded in the Transactions for 1917 and 1918. Our search, however, has been extended to include the woods in the Horsley district, which is the beginning of the chalk soil and is characterised by an abundance of beech. *Sistotrema variecolor* is included for its interest, though found in Hampshire. The list includes a number of species new to Britain, and we wish to express our gratitude to Monsieur l'Abbé Bourdot for valued help in determining many of these.

*Tulasnella incarnata* Juel.

This species is probably not uncommon in this country, but may be mistaken for a thin form of *Peniophora incarnata*, although there is a distinct difference in the colour when the two plants are compared.

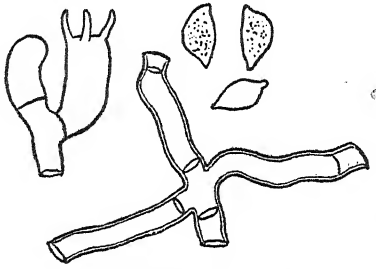
*Hypochnella violacea* (Awd.) Schroet.

The second record for Britain. It was found for the first time during the Doncaster Foray in 1914.

*Corticium flavescens* (Bon.) Mass. in Journ Linn. Soc. XXVII, 1890, p. 149. *Hypochnus flavescens* Bon., Handb. p. 160.

Irregularly effused, thin and pulverulent, whitish to dirty buff, with the habit of *C. botryosum*. Hymenium loose, as in

other allied species. Basidia oblong or clavate, 20–30 × 12–13 $\mu$, with 2–4 curved sterigmata, 8$\mu$ long. Spores somewhat lemon-shaped, apiculate at either end, and flattened on the inner side 15–17 × 7–9$\mu$ (most 15 × 8$\mu$). Basal hyphae septate, hyaline or yellowish, without clamp-connections, branched at right-angles, loosely interwoven.



*Corticium flavescens.* ×550.

On rotten wood, St George's Hill, Weybridge, February 1920, A. A. P.

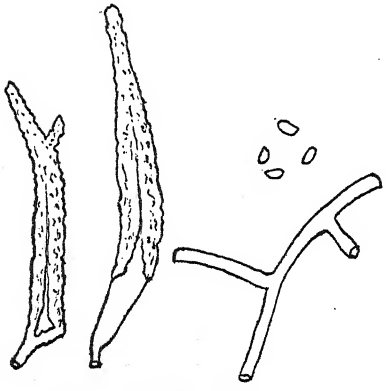
The species occurred abundantly, but most of the specimens were sterile. Fortunately some good fruiting specimens were obtained, and recognised at once by the characteristic spore.

*Corticium praetermissum* (Karst.) Bres.

The form which has been described as *Gloeocystidium tenue* (Pat.) von Hoehn. & Litsch. occurred amongst the typical form. *G. tenue* has cystidia which are very prominent, and are frequently swollen into a subglobose head at the apex and surmounted by a deposit of calcium oxalate. Intermediate forms occur so frequently that it is impossible to keep this form specifically distinct from *G. praetermissum.*

*Peniophora leprosa* Bourd. & Galz. in Bull. Soc. Myc. Fr. XXVIII, 1912, p. 394.

Irregularly effused, somewhat thick and crustaceous, margin white, indeterminate, occasionally prolonged into white rhizomorphic strands. Hymenium pinkish-ochraceous, somewhat cracked when dry, and rough with cystidia under the lens. Cystidia very rough, cylindrical to sub-fusiform, frequently occurring in clusters, so as to give an Odontia-like appearance, occasionally branched near the apex, 60–90 × 8–14$\mu$. Basidia inconspicuous, about 4$\mu$ wide. Spores elliptical, 4–6 × 2·5–3$\mu$. Basal hyphae 3–4 (–7)$\mu$, often strongly encrusted with crystals, clamp-connections rare.



*Peniophora leprosa.* ×550.

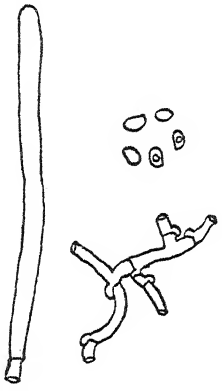
On dead bark, Horsley, April 1920, A. A. P.

This plant is very like *P. velutina* in appearance, and has similar spores, but it is distinguished by the much finer encrusted hyphae, and by the cystidia. Bourdot and Galzin give it as a subspecies of *P. radicata*, but it appears to us to be sufficiently distinct to rank as a species.

*Peniophora detritica* Bourd. in Rev. sc. du Bourb. 1910, p. 13, and Bull. Soc. Myc. Fr. XXVIII, 1912, p. 389.

Pure white, effused, very thin, with scattered granules suggesting a Grandinia. Hymenium not continuous, appearing farinaceous under the lens. Cystidia cylindrical or narrowly club-shaped, smooth, thin-walled, obtuse at the apex, 70–90 × 5–6$\mu$. Spores broadly elliptical or obovate, one-guttulate, 5–6 × 4$\mu$.

On rotten wood, St George's College, Weybridge, February 1920, A. A. P.



*Peniophora detritica.* × 550.

*Peniophora laevigata* (Fr.) Mass.

On yew logs, Horsley. The species is fairly common on yew in this district. The specimens gathered were of two kinds; some in thin small well-defined patches; other elongated and several mm. thick, representing apparently the successive growth of several years.

*Jaapia* Bres. in Ann. Myc. IX, 1911, p. 428.

Resupinate, effused, immarginate, flocculose-pulverulent, with the habit of some Corticia or of a pale Hypochnus; spores straw-coloured, sub-elliptical, hyaline-appendiculate.

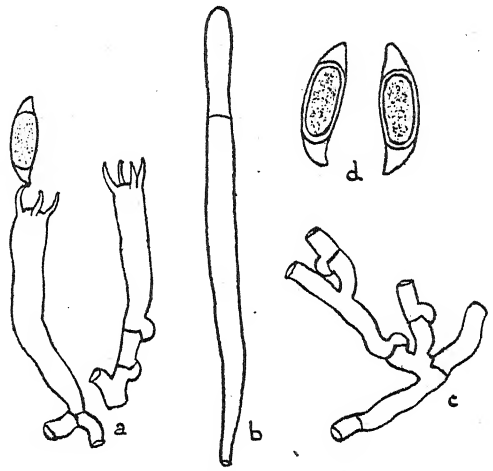
The genus is distinguished by the peculiar spores.

*J. argillacea* Bres. loc. cit.

Irregularly effused, very thin, flocculose, sometimes with scattered granules, clay-coloured; hymenium at first loose, later more continuous. Cystidia present, cylindrical, obtuse, occasionally with a single septum, 100–160 × 7–8$\mu$. Basidia clavate, up to 60$\mu$ long, 8–10$\mu$ wide, with 2–4 curved sterigmata, 8$\mu$ long. Spores fusiform, slightly curved, 22–25 × 7–8$\mu$, consisting of a central oblong-elliptical portion, 14–18 × 7–8$\mu$ (most 15 × 7$\mu$), containing faintly-coloured, granular protoplasm, divided off by a wall from a clear conical portion at either end. Basal hyphae flexuous, frequently septate, with clamp-connections, 4–6$\mu$ in diameter.

On a fallen stick, St George's Hill, Weybridge, October 1919, A. A. P.

In this material it was possible to see the peculiar spores attached to the basidia, as drawn, hence the suggestion which has




*Jaapia argillacea.*
*a. Two basidia*
*b. Cystidium* } ×550.
*c. Hyphae*
*d. Spores* ×850.

been made that the species represents a chlamydospore form of *Coniophora arida* is disproven. The mode of development of the spores could not be observed in the scanty material available.

*Hymenochaete corrugata* (Fr.) Lév.

The spore-measurements for this species are erroneously given in Massee's Fungus Flora as 7–8 × 4–5$\mu$. In this specimen the spores were very slender and cylindrical, about 6–7 × 1·5$\mu$. This agrees with the measurements given by Burt (4·5–7 × 1·5–2$\mu$).

*Grandinia granulosa* Fr.

*Odontia fimbriata* (Pers.) Fr.

*Hydnum udum* Fr.

*Sistotrema variecolor* Bourd. & Galz. in Bull. Soc. Myc. Fr. xxx, 1914, p. 274.

Effused, soft and membranaceous; slightly separable, sulphur-yellow when fresh, becoming paler when dry. Hymenium with scattered subulate teeth and granules. Tissue of loosely interwoven hyphae, varying from 1·5–5$\mu$ in diameter, with occasional clamp-connections. Basidia about 30 × 8–9$\mu$ with 4

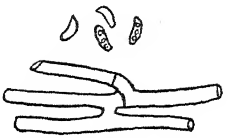
curved sterigmata, 6$\mu$ long. Spores yellow, obovate, one-guttulate, at first smooth then finely aculeate 6–8 (–10) × 4–5·5$\mu$.

On a fallen twig, Farnborough, Hampshire, Rev. P. J. Alexander and A. A. P.

We are indebted to M. Bourdot for the identification of this plant. It is certainly not a Sistotrema in habit, but according to M. Bourdot it is very closely allied to *S. sulphureum*, a plant which is unknown to us. The habit of our plant is that of a Radulum, but it is distinguished from *R. mucidum*, the other yellow species of Radulum, by the large rough spores.

*Poria farinella* Fr.

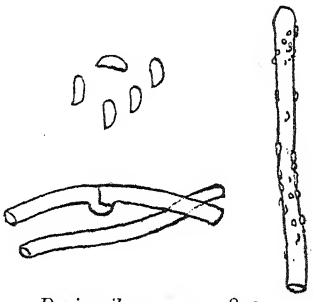
This is distinguished among the white species of Poria by the shallow, angular pores, the very thin substance, and the curved cylindrical spores, 8–9 × 2–2·5 $\mu$. The hyphae are rather straight, 4–5$\mu$ in diameter, and without clamp-connections.



*Poria farinella.* ×550.

*Poria gilvescens* Bres. in Ann. Myc. VI, 1908, p. 40.

Effused, bleeding, at first white, then flesh-coloured, at length brownish, margin tomentose, persistently white, subiculum scarcely evident; tubes 1–4 mm. long, soft, sub-fleshy; hyphae about 3$\mu$ in diameter, yellowish. Pores sub-rotund, apex at length fimbriate, often oblique, medium-sized, variable. Spores hyaline cylindric-curved, 4·5–5 × 1·5–2$\mu$. Basidia clavate, 12–16 × 4$\mu$. Subhymenial hyphae hyaline, 2·5–3·5$\mu$ thick.



*Poria gilvescens.* ×850.

Grounds of St George's College, Weybridge, 1918–1920, A. A. P. and Rev. P. J. Alexander, C.J.

We are again indebted to M. Bourdot for the identification. The plant has appeared for some years on an old beech stump. It resembles *P. adiposus* in habit, but is at once distinguished by having allantoid instead of subglobose spores. The hyphae of the pore-walls are frequently encrusted with mineral matter, and encrusted hairs like that illustrated may project from the pore mouths. This is particularly noticeable under damp conditions, when the pore-mouths become whitish.

# NEW OR RARE BRITISH FUNGI.

With Plate VII.

*By Carleton Rea, B.C.L., M.A., etc.*

*Amanita aculeata* Quél. Quél., Fl. Myc. 305; Quél., Champ. du Jura et des Vosges, I, 309, as *Amanita echinocephala* Vitt., t. I, fig. I, as *Amanita strobiliformis* Fr. Cke. Illus. no. 1102, t. 939, as *Agaricus* (*Amanita*) *solitarius* Bull.

Pileus 5–10 cm. wide, *white, becoming greyish,* fleshy, convex, then plane, *densely covered with erect, slender, pointed, angular, firm, adnate, whitish or greyish warts, that become tinged with bistre with age*; margin *white,* smooth. Stem 5–12 cm. long, 2–5 cm. thick, *whitish,* solid, equal, floccosely scaly; base bulbous, often attenuated downwards, *surrounded by several concentric, crenulate zones,* the remains of the volva. Ring *white,* superior, thin, torn, striate, often becoming fugacious. Gills *white,* becoming yellowish with age, 5–15 mm. wide, sinuate behind, crowded. Flesh *white,* then tinged with yellow, thick, soft. Smell and taste pleasant. Spores white, broadly elliptical, or subglobose, with a basal apiculus, 10–11 × 8–9$\mu$, contents granular.

On the ground amongst beech leaves, Wood Norton, Worcestershire, 12th October, 1918.

Easily known by the firm, erect, pointed, angular warts on the pileus from the very first. In *Amanita strobiliformis* (Paul.) Quél. the warts are large, pyramidal, floccose and somewhat separable, and in *Amanita solitaria* (Bull.) Fr. the warts are plate-like, floccose at first, but becoming firmer with age. *Amanita Vittadinii* Moretti differs in the gills finally becoming greenish.

*Lepiota scobinella* (Fr.) Quél. & Bataille. Quél. & Bataille, Fl. Monogr. des Amanites et des Lépiotes, 69; Fr., Hym. Eur. 26, as *Agaricus* (*Amanita*) *scobinellus* Fr., see Pl. VII.

Pileus 3–6 cm. wide, *mouse grey, disc darker,* convex, then plane, umbonate, *pellicle breaking up into minute, separable, bistre scales;* margin *whitish,* smooth, silky. St. 4–6 cm. long, 4–7 mm. thick, *white,* stuffed, equal, slightly attenuated at the apex and base, *covered with white squamules, that become tinged*

*with bistre, below the ring, striate above.* Ring *whitish, becoming tinged with bistre at the edge,* membranaceous, superior, often fugacious. Gills *white, becoming yellowish,* 3–4 mm. wide, ventricose, free, crowded. Flesh white, often tinged with fulvous at the base of the stem, thick at the disc, very thin at the margin of the pileus, floccose. Smell and taste none. Spores white, elliptical, 6–7 × 3–4$\mu$, contents granular. Cystidia hyaline, clavato-cylindrical, 28–30 × 6$\mu$, sparse.

On the ground, Benthall, Shropshire, 29th September, 1918.

Easily distinguished from *Lepiota clypeolaria* (Bull.) Fr. by the minute, separable, bistre scales on the pileus, the white, squamulose stem, and the much smaller spores.

*Tricholoma inodermeum* Fr. Fr., Monogr. I, 66.

Specimens of this rare Agaric were collected by Mr W. B. Allen, at Wood Norton, Worcestershire, on the 12th October, 1918. The spores are hyaline, elliptical, obtuse at both ends, more rarely with a basal apiculus, 8–9 × 5$\mu$, 3–4-guttulate. Cystidia none.

*Pleurotus serotinus* (Schrad.) Fr., var. *Alméni* (Fr.) Big. & Guill. Big. & Guill., Fl. des Champ. Supér. de France, II, 120; Fr., Hym. Eur. 176; Fr., Icon. t. 87, fig. 3, as *Agaricus* (*Pleurotus*) *Alméni* Fr.

Differs from the type in its larger size, the tawny fuscous pileus and paler stem and gills. Spores white, sausage-shaped, 5–6 × 1·5$\mu$.

On a fallen log, West Kilbride, Ayrshire, 25th November, 1918, Mr R. B. Johnstone.

MYCENA ATROVIRENS Rea, v. Pl. VII.

Pileus 8 mm. latus, centro *atrovirens,* margine striato *albidus pallidusve,* circa marginem *laete viridis,* carnosulus, hemisphaericus, levis, centro primitus subviscidus. Stipes 3 cm. longus, 1 mm. crassus, *cinereus* vel *griseo-fuligineus,* aequalis, fistulosus, levis. Lamellae *albidae, acie minute denticulatae et virides praecipue versus marginem pilei,* adnatae, 2 mm. latae, subdistantes, antice attenuatae. Caro *fusca,* tenuis, inodora et insapora. Sporae hyalinae, ellipticae, utrinque vel oblique acutatae, 5–6 × 3–4$\mu$, minute punctatae; basidia clavata, 23–25 × 6–7$\mu$, 4-sterigmatibus. Cystidia acie lamellarum numerosa, saepe fasciculata, longe subclavata vel cylindracea, 35–40 × 3–4$\mu$, flexuosa, *succo chlorino repleta,* tenuiter tunicata.

Ad truncos *Fagi sylvaticae,* Leeds, 26th October, 1919, Coll. F. A. Mason.

Easily known amongst the Calodontes by the green edge of the gill.

*Mycena dilatata* Fr. Fr., Hym. Eur. 151; Fr., Icon. t. 84, fig. 3. See Pl. VII.

*Wholly white.* Pileus 5–10 mm. wide, membranaceous, convexo-plane, obtuse, smooth; margin striate. Stem 10–15 mm. long, 1 mm. thick, filiform, straight, *arising from a convex, smooth, glabrous, orbicular disc.* Gills ·5–1 mm. wide, sublinear, *attached to a free collar behind.* Flesh white, thin. Spores white, oblong, obtuse at both ends, 7–8 × 3·5$\mu$. Cystidia hyaline, clavate, obtuse, or produced into an acute point, 70–80 × 5–7$\mu$.

On dead twigs, Highlow Wood, Derbyshire, 24th September, 1919.

Easily known amongst the Basipedes group by the gills being attached to a free collar.

MARASMIUS OBTUSIFOLIUS Rea, v. Pl. VII.

Pileus 1–2 cm. latus, *albidus, centro fulvus,* membranaceus, convexo-planus, papillatus, levis, *sulcatus;* margine primitus involuto. Stipes 2–4 cm. longus, 1 mm. crassus, *fulvus, apice albus,* aequalis, solidus, minute velutinus. Lamellae *pallidae,* adnatae, *postice annulato-conjunctae,* 2 mm. latae, valde distantes, aequales, *obtusissimae,* crassae, acie sub lente cystidiis prominentibus dense fimbriatae. Caro alba, lenta, tenuis, inodora et insapora. Sporae hyalinae, late ovatae, vel subglobosae, 14–15 × 10–12$\mu$, intus guttula media, crassa repletae, crassiuscule tunicatae; basidia clavata, 2–4-sterigmatibus. Cystidia numerosa, fusideo-ventricosa, 95–140 × 17–25$\mu$, apice capitata, 14–18$\mu$ in diam., tenuiter tunicata. Cuticula pilei cellulis subglobosis, vel subpyriformibus, 20–23$\mu$ in diam.

Ad radices *Carpini Betuli,* Epping Forest, Essex, 18th October, 1919, Coll. C. H. Grinling.

Easily known by the blunt, *Cantharellus*-like gills which are densely ciliate on the margin under a lens with the projecting cystidia, and the large, broadly ovate, or subglobose spores. It should be placed after *Marasmius torquescens* Quél.

PLUTEUS PHLEBOPHORUS (Dittm.) Fr. var. ALBO-FARINOSUS Rea.

A typo differt *apice stipitis albo-farinoso.* Cystidia hyaline, clavate, 25–35 × 10–12$\mu$.

On rotten wood, Shrawley Wood, Worcestershire, 12th October, 1919, Miss Violet Rea.

*Leptonia euchlora* (Lasch.) Fr. Fr., Hym. Eur. 204; Boud., Icon. Myc. IV, 50, t. 99.

Pileus 1·5–3·5 cm. wide, *olivaceous, becoming paler,* submembranaceous, campanulato-convex, then plane, *fuscous fibrillose, subsquamulose,* especially at the darker, finally depressed disc.

Stem 3–6 cm. long, 3–5 mm. thick, *greenish, apex yellowish, becoming deep blue, or verdigris when bruised or handled,* equal, slightly thickened at the white, tomentose base, hollow, fragile, smooth. Gills *whitish, or very pale yellowish,* then *pink,* 5–6 mm. wide, broadly adnate, subdistant. Flesh *greenish, becoming deep blue, or verdigris when bruised or pressed,* thin. Taste and smell none. Spores pink, oblong, angular, 11–15 × 8–10$\mu$, multi-guttulate.

Amongst short grass, Benthall Edge, Shropshire, 20th September, 1919.

Differs from *Leptonia incana* Fr. in the stem and flesh becoming deep blue or verdigris when bruised or handled, the non-umbilicate, subsquamulose pileus and the absence of a mouse-like smell.

NOLANEA STRIGOSISSIMA Rea, v. Pl. VII.

Pileus 4–8 mm. latus, 3–5 mm. altus, *rufobrunneus,* vel *ferrugineus,* carnosulus, conico-campanulatus, *pilis erectis, strigosis, elongatis, obtusis, rufobrunneis et septatis dense obtectus,* 450–600 × 15–20$\mu$; margine involuto. Stipes 1·5–2·5 cm. longus, 1 mm. crassus, *pilei concolor,* aequalis, basi leviter incrassatus, e farcto cavus, *pilis similibus dense obtectus.* Lamellae *e brunneo cinereae,* demum albo-pruinosae, adnatae, angustae, 1 mm. latae. Caro *concolor, cinerascens,* tenuis, firma, inodora et insapora. Sporae pallide roseae, oblongae, angulatae, saepe apiculatae, 15–17 × 7–8$\mu$, 2-guttulatae; basidia pyriformia, vel clavato-capitata, 36–40 × 15–18$\mu$, 4-sterigmatibus arcuatis, 3$\mu$ longis. Cystidia acie lamellarum parca, fusiformia, vel lanceolata, 60–70 × 10–12$\mu$, apice acuta, tenuiter tunicata. Cuticula pilei cellulis pyriformibus, 25$\mu$ in diam.

Ad ligna mucida *Pini sylvestris,* St George's College, Weybridge, Surrey, 9th October, 1919. Coll. Rev. Philip J. Alexander, S.J.

Easily known amongst the Nolaneae by the densely strigose pileus and stem.

*Pholiota subsquarrosa* Fr.

Spores ochraceous, oblong-elliptical, 4·5–5 × 2–2·5$\mu$. Cystidia ochraceous, fusiform, tapering into a long exserted point, 25–30 × 6–8$\mu$, thick walled; contents yellowish, granular.

New Piece Wood, Chatsworth, Derbyshire, 26th September, 1919, Dr Harold Wager.

*Inocybe conformata* Karst. Karst., Krit. Öfvers. Finl. Basid. (1889), 465; Massee, Monog. of the genus Inocybe, 488.

Pileus 1–3 cm. wide, *pale fuscous, or tinged rusty,* convex, then

expanded, umbonate, fibrillosely rimose, sometimes minutely, appressedly, floccosely squamulose. Stem 3–5 cm.long, 3–6 mm. thick, *concolorous, apex at first tinged violet,* equal, often flexuose, solid, minutely fibrillose. Gills *pallid, then brownish,* 4–5 mm. wide, adnexed, ventricose, somewhat crowded; margin white, fimbriate. Flesh white, brownish under the cuticle of the pileus, bluish at first in the stem, thick at the disc, very thin at the margin of the pileus, firm. Smell and taste none. Spores brownish in the mass, oblong-elliptical, depressed on one side, 8–11 × 4–5$\mu$. Cystidia hyaline, fusiform, ventricose, apex muriculate, 65–75 × 15–19$\mu$.

On the ground under oaks, Bishop's Wood, Selby, Yorkshire, 9th September, 1918.

ASTROSPORINA *Schroet.*

This genus has the same characters as *Inocybe* but differs in having irregular, angular, echinulate, or verrucose, ochraceous or ferruginous spores and *Inocybe* becomes restricted to species having smooth, elliptical, ochraceous or ferruginous spores.

*Astrosporina lanuginella* Schroet. Schroet., Pilzfl. von Schlesien, I, 577.

Pileus 1·5–3 cm. wide, *tawny, or greyish brown,* campanulato-convex, then plane, obtusely umbonate, fibrillose, cracked ("fibrils septate, apical cell 35–40 × 8–11$\mu$, with rounded ends," sec. Schroeter). St. 1·5–5 cm. long, 1·5–5 mm. thick, *pallid, apex at first delicately tinged with lilac, base brownish,* equal, fibrillose. Gills *pallid, then cinnamon,* 2–3 mm. wide, slightly adnexed, somewhat crowded, edge fimbriate. Flesh *white, tinged reddish under the cuticle of the pileus and stem,* thick at the disc, thin at the margin of the pileus, firm. Smell and taste none. Spores cinnamon in the mass, oblong, obtusely angular, 8–11 × 5–7$\mu$. Cystidia hyaline, either fusiform, ventricose, obtuse at the apex, muriculate or not, 40–70 × 15–23$\mu$, or acicular and acute.

On the ground in a cart track through oak woods, St George's Hill, Weybridge, Surrey, 4th August, 1919, Mr A. A. Pearson.

ASTROSPORINA FULVA Rea, v. Pl. VII.

Pileus 3–4 cm. latus, *fulvus, centro obscuriore,* carnosus, e convexo expansus, longitudinaliter adpresse fibrillosus, margine tenuis. Stipes 5–6 cm. longus, 5–6 mm. crassus, *pilei concolor, apice e lilacino expallens,* aequalis, basi leviter attenuatus, farctus, *fibrilloso-striatus.* Lamellae ex *albo ochraceae,* acie pallidiores, postice sinuato-adnatae, 6–7 mm. latae, subconfertae. Caro pilei alba, stipitis *leviter rubescens,* tenuis, inodora et insapora. Sporae ochraceo-flavae, oblongae, angulato-tubercu-

losae, 10 × 5–6·5$\mu$. Cystidia hyalina, *vesciculosa*, obtusa, 42 × 20$\mu$, tenuiter tunicata.

Ad terram nudam in sylvis frondosis, Bishop's Wood, Selby, Yorkshire, 9th September, 1918.

Known by the bluish apex of the stem, the flesh of the stem becoming reddish, and the obtuse, bladder-like cystidia.

*Caldesiella italica* Sacc. Sacc., Syll. VI, 477.

Receptacle 2–10 cm., *fuliginous*, widely effused, incrusting, resupinate. Spines *concolorous, becoming olivaceous with the snuff-coloured spores*, 1–1·5 mm. long, ·5–1 mm. thick, cylindrical, obtuse, often compressed, crowded, pruinose. Flesh *concolorous*, floccose, thick. Spores snuff coloured in the mass, olivaceous hyaline under the microscope, obtusely verrucose, angularly globose, 8–9 × 8$\mu$; basidia clavate with 2–4-sterigmata. Basal hyphae concolorous, thick walled, 6–8$\mu$ in diam., septate, with clamp-connections.

On a dead birch stump, Trench Woods, Worcestershire, 20th October, 1917.

I am indebted to Miss E. M. Wakefield for kindly determining this species.

*Puccinia Picridis* Hazsl. Math. és Termés. Közlemények m. Tudományos Akad. XIV, 152 (1877).

*Uredospores*. Sori amphigenous, without spots, or on very indistinct spots, scattered, sometimes confluent, minute, punctiform, round, pulverulent, *cinnamon*; spores globose, subglobose, or broadly ovate, echinulate, pale brown, 21–27$\mu$ in diam., or 24–30 × 16–20$\mu$, with two germ-pores.

*Teleutospores*. Sori similar, *dark brown*; spores elliptical, or ovate-elliptical, rounded at both ends, not thickened above, not or hardly constricted at the septum, delicately verruculose, brown, ·27–35 × 18–24$\mu$; epispore thin; pedicels hyaline, up to 16$\mu$ long.

On leaves of *Picris hieracioides*, Colesbourn, Gloucestershire, 6th September, 1919, Mr H. H. Knight.

In this gathering both spore forms were obtained. The uredospores were echinulate, globose, or subglobose, 28–30 × 25–28$\mu$; and the teleutospores delicately verruculose, especially in the upper half, 35–40 × 23–25$\mu$.

*Acetabula calyx* Sacc. Sacc., Myc. Ven., Patavia (1873), 168; Boud., Icon. IV, 133, t. 248.

Ascophores 2–6 cm. wide, *greyish bistre*, or *fuliginous*, externally *greyish*, pruinose, fleshy, cup-shaped, then expanded and finally *reflexed*, stipitate, hymenium smooth; margin often crenulate and becoming split. St. 1–6 cm. (generally 1–2 cm.) long,

1–2 cm. thick, *whitish*, at first short, cylindrical, longitudinally ribbed, the single ribs sometimes extending for a very short distance on the exterior of the ascophore, glabrous. Flesh *white*, solid or lacunose. Asci cylindrical, attenuated and somewhat flexuose at the base, 330–350 × 18–21$\mu$, 8-spored, operculate, not turning blue with iodine. Spores hyaline, broadly elliptical, 20–23 × 11–13$\mu$, with a large central gutta, accompanied by several smaller guttae at either end, 1-seriate. Paraphyses *fuliginous*, clavate or slightly thickened at the apex, 340–360 × 3$\mu$, × 6–8$\mu$ at the apex, simple or branched, septate.

On garden soil, Woodcote, Weybridge, Surrey, 2nd May, 1920, Mr A. A. Pearson.

Easily distinguished from the other British species of Acetabula by the distinct stem and revolute receptacle.

*Lachnea hemisphaerioides* Mout. Mout., Compt. rend. Bull. Soc. Roy. Bot. Belg. XXXVI, 2nd fasc., 21 (1897).

Ascophores 5–15 mm. wide, gregarious or scattered, sessile, urceolate, then hemispherical, concave; hymenium *white, becoming greenish*; externally clothed, especially towards the margin, with simple, straight, *fuscous*, multi-septate, gradually tapering, acute hairs, 100–340 × 8–15$\mu$, sometimes the hairs are hyaline or become so with age. Asci cylindrical, 200–260 × 8–12$\mu$, 8-spored, operculate, not colouring blue with iodine. Spores white, elliptical, 12–16 × 7–8$\mu$ (average 14 × 7·5$\mu$), with a moderate sized guttula at each end, 1-seriate. Paraphyses hyaline, linear, slightly thickened at the apex, 130–280 × 3–4$\mu$, septate.

On an old cinder heap in a wood, West Porlock, Somersetshire, 9th April, 1920, Mr Norman G. Hadden.

I am much indebted to Mr J. Ramsbottom for kindly identifying and supplying me with the descriptions of this species and that of *Hyaloscypha radio-striata* (Feltg.) Boud.

*Ombrophila verna* Boud. Boud., Soc. Myc. Fr. IV, 77; Boud., Icon. Myc. IV, 250, t. 435.

Ascophores 4–8 mm. wide, *ochraceous, paler outside*, plane, lense-shaped, stipitate, very minutely fibrillose; margin entire, or slightly crenulate, not or scarcely prominent; hymenium *ochraceous*, or *ochraceous fuscous*, never rose-coloured, plane, or slightly convex. Stem 4–8 mm. long, 1–2 mm. thick, *blackish brown at the base*, pulverulent, or fibrillose. Flesh *ochraceous, blackish in the stem*. Asci cylindrico-clavate, slightly attenuated at the base, 90–100 × 9–10$\mu$, 8-spored. Spores hyaline, smooth, oblong, hardly fusiform, often depressed on one side, 9–15 × 4–5$\mu$, either with a small oil drop at each end, or with cloudy con-

tents. Paraphyses hyaline, simple, continuous, rarely septate, obtuse, slightly thickened at the apex, 85–98 × 3–3·5μ, contents granular.

On *Sphagnum* and dead grass haulms, Possil Marsh, near Glasgow, Lanarkshire, 27th May, 1919, Mr W. Rennie.

It differs from *Ombrophila clavus* (A. & S.) Fr. in colour, the receptacle is less convex, flatter and acuter at the margin, the paraphyses are more obtuse, the smaller asci less attenuated at the base and the spores are not fusiform.

*Hyaloscypha radio-striata* (Feltg.) Boud. Feltgen, Verstudien zu einen Pilz-Flora des Grossherzogthums Luxemburg; 1 Thiel, Nachtrage III (1903), 52–53.

Ascophores ·3–·5 mm. wide, *pallid*, or *ochraceous*, waxy, subpellucid, sessile, globose, punctiform, closed at first and when dry, then cup-shaped, and often finally becoming plane; externally *whitish or ochraceous* when moist, white floccose at base, *becoming deeper yellow, or brownish yellow when dry*; margin radiately striate or ribbed, *ciliato-dentate*, teeth triangular, marginal hairs hyaline, subclavate, connate, 40–60 × 4–5μ; hymenium *pallid* or *yellowish*. Asci clavate, 40–70 × 5–6μ, apex narrowed, obtuse, inoperculate, foramen slightly marginate, pore turning blue with iodine, 8- (rarely fewer) spored. Spores hyaline, oblong, more rarely clavate, 7–11 × 1·5–2μ, continuous, finally becoming sometimes 1-septate, obliquely 1–2-seriate. Paraphyses hyaline, filiform, 65–75 × 1–2·5μ, often slightly attenuated upwards. Hypothecium pale yellow, *pseudoparenchymatous*, cells 5–6μ in diam.

On dead stems of *Symphytum officinale*, Perth, 9th May, 1920, Mr James Menzies.

Von Höhnel in Annales Mycologici, XV, no. 5 (1917), 347–349, creates a new genus *Pezizellaster* for the reception of this and two other nearly related species and bases it on the distinctly toothed margin and large-celled pseudoparenchymatous hypothecium.

*Urceolella leucostoma* (Rehm) Boud. Rehm in Rabh. Krypt. Fl. 1, 3, 845, and figs. 1–4, 827, as *Dasyscypha leucostoma* Rehm. See Pl. VII.

Ascophores ·3–·5 mm. wide and high, gregarious, waxy, sessile on a broad base, globose and closed at first, then open and concave, becoming urceolate when dry, externally *reddish brown*, or *dark purple*, densely clothed with soft, slender, blunt, roughish septate, brown hairs, 100–170 × 3μ, hairs colourless at the margin; hymenium at *first tinged with pink, then becoming cinereous, margin white*. Asci cylindrical, 50–100 × 5–7μ, apex rounded,

thickened, pore turning blue with iodine, 8-spored. Spores hyaline, oblong, or oblong-fusiform, generally straight, continuous, 7–12 × 1·5–2$\mu$, often with a small oil drop at each end, 2-seriate. Paraphyses hyaline, slender, 60–110 × 1–1·5$\mu$.

On dead stems of *Oenanthe crocata*, Perth, 21st July, 1919, Mr James Menzies.

Easily known by the whitish edge of the receptacle when dry.

URCEOLELLA IRIDIS Rea, v. Pl. VII.

Ascomata ·5–1 mm. lata, *flavo-virens, dein cinerea*, ceracea, gregaria, sessilia, urceolata, siccitate contracta, extus puberula, pilis albis, obtusis, basi incrassatis, 3–4-septatis, apice intus dense granulosis, 60–70$\mu$ longis, basi 8$\mu$ crassis. Asci cylindracei, basi parum constricti, apice acuti, 70–80 × 10-11$\mu$, octospori, foramine immarginato, iodo haud tincti; sporae hyalinae, leves, oblongae, vel subfusiformes, 13–15 × 4–4·5$\mu$, intus minute granulosae. Paraphyses hyalinae, filiformes, apice vix incrassatae, 55–70 × 2$\mu$.

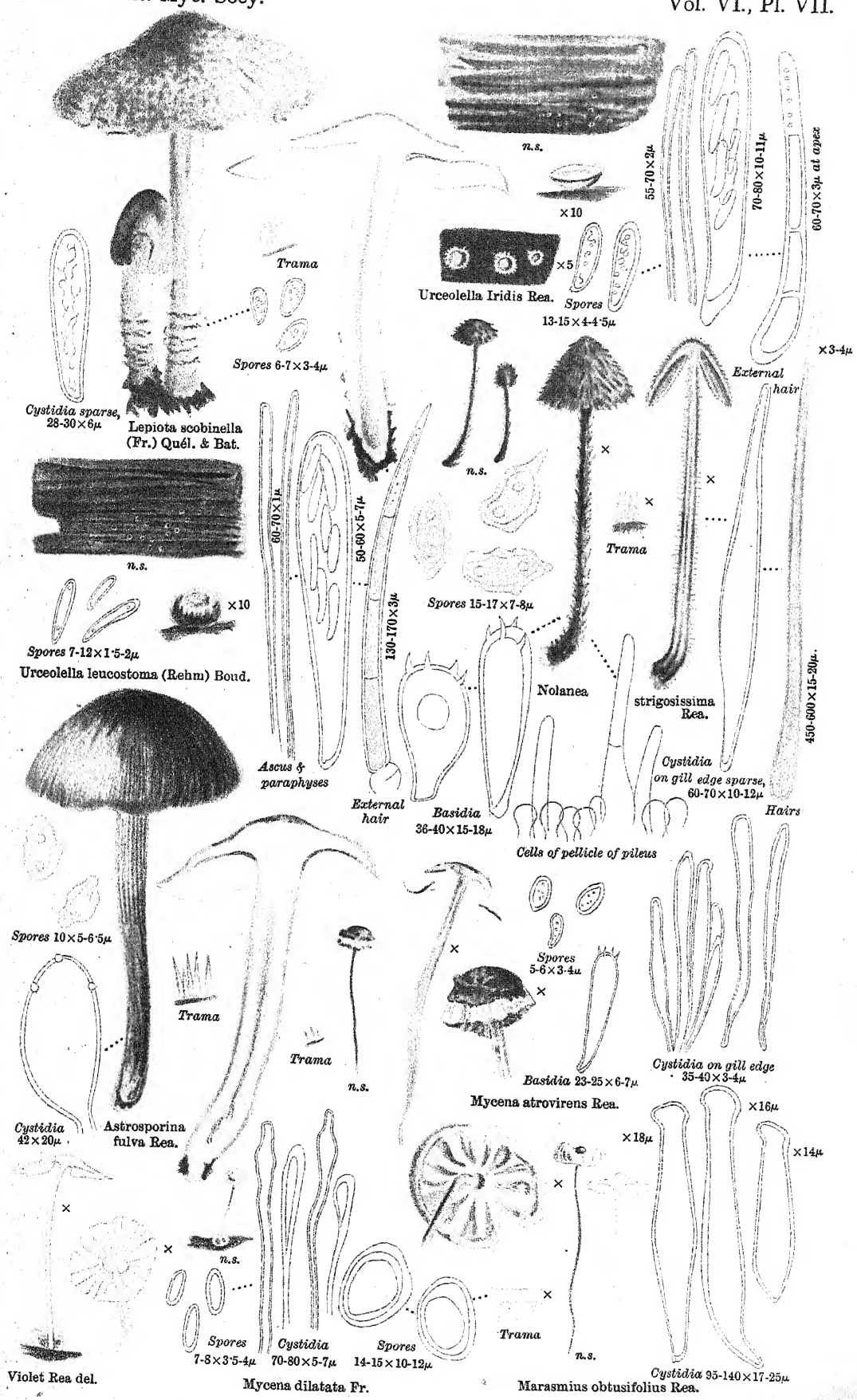
Ad folia putrida *Iridis pseudacori*, Methven Loch, Perthshire, 5th July, 1919. Coll. J. Menzies.

*Urceolella pseudacori* (Feltg.) Boud., which is also found growing on decaying leaves of *Iris pseudacorus*, differs in the hyaline, pale yellow, shortly stipitate receptacle and the smaller spores.

*Pyrenopeziza millegrana* Boud. Boud., Hist. et class. Disc. 133; Boud., Icon. Mycol. IV, 326, t. 552.

Ascophores ·30–·60 mm. wide, crowded, sessile, globose, urceolate, then cup-shaped; margin very prominent, entire, white; hymenium greyish; externally fuliginous, covered with short, brown, septate hairs, 5–7$\mu$ in diam., arranged in irregular, indistinct ribs below the glabrous margin. Asci oblong-fusiform, slightly attenuated at the base, 60–70 × 10–11$\mu$, 8-spored, inoperculate, not colouring blue with iodine. Spores white, fusiform, 20–28 × 4–5$\mu$, straight or somewhat curved, multi-guttulate, oil drops yellow. Paraphyses pallid, filiform, not thickened at the apex, 60–70 × 3$\mu$, simple or branched, sparsely septate.

On dead stems of *Spiraea Ulmaria*, Perth, 20th April, 1920, Mr James Menzies.

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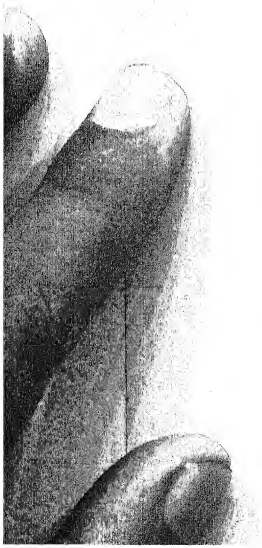

# ON A NEW SPECIES OF MELANOTAENIUM WITH A GENERAL ACCOUNT OF THE GENUS.

With Plate VIII.

*By Rudolph Beer, B.Sc., F.L.S.*

During the early summer of 1918 specimens of White Dead-nettle (*Lamium album*) bearing curious tumour-like swellings caused by a fungus upon their underground organs were sent to the Pathological Laboratory at Kew. The diseased plants had been found by Mr W. F. Drew at Chalfont, Stroud, Gloucestershire, and upon request he kindly sent in 1919 a further sample of plants from the same locality in rather an advanced state of disease.

There appears to be no other record of the occurrence of such intumescences upon *Lamium album* and a careful search both at Kew and elsewhere failed to discover any further examples of these tumours. It would appear, therefore, that the disease is a rare one and in spite of the small amount of material available for study it seems advisable to place the fact of its occurrence upon record and to give a brief description of its general characters and of the fungus causing it.

*Description of New Species and its Systematic position.*

As already mentioned the tumour-like swellings occur upon the subterranean parts of the plant (Pl. VIII, fig. 1). In so far as the present material permits one to judge the intumescences are restricted to the underground stems and leaf-structures and are entirely absent from the roots and from the sub-aerial parts of the plant. In some cases they occur as dark blister-like swellings upon the side of the stem but when the entire circumference of the stem is affected they appear as distinct, spherical, tuberous bodies measuring as much as 8·5–9 mm. in diameter. When a bud is attacked it becomes much swollen and its leaf-organs greatly thickened and enlarged.

The presence of the disease does not cause the differentiation of any new structures in the organ but it stimulates the elements already present in the leaf or stem to division and growth. The swellings would, therefore, according to Küster's classification fall within the category of Kataplasmic galls*.

* Küster (1903) divides galls into two groups: (*a*) those which show little or no differentiation and are quite simple in their histological structure, and (*b*) those which exhibit specific differentiation and have quite a different histological structure from the normal organ. The former he names Kataplasmic galls, the latter Prosoplasmic galls.

A section through one of the galls shows that a fungus is present and the general characters of this, with its large brown spores, evanescent mycelium and intercellular development, indicate that it is a member of the Ustilagineae.

As is well known the most important feature distinguishing the two groups into which this family is divided consists in their mode of spore germination. In the Ustilaginaceae the promycelium is divided by septa and the conidia are borne laterally whilst in the Tilletiaceae the conidia arise in a terminal whorl from the apex of the promycelium.

Unfortunately all attempts to bring about the germination of the spores of the present fungus in hanging drops have been unsuccessful so that dependence must be placed on other characters to determine whether the organism falls within the Ustilaginaceae or the Tilletiaceae.

It has been pointed out by Lutman (1910) in his paper on the "Life History and Cytology of the Smuts" that the two groups contrast with one another in the development of their haustoria. "The Ustilagos apparently get sufficient nourishment from their host plants by occupying intercellular spaces and perhaps by occasionally passing through a host cell. The smuts of the Tilletia group on the other hand have well developed haustoria in three species at least."

This character is by no means of universal application as several species of Ustilago, such for instance as *U. Vaillantii* Tul. described by Miss Massee (1914), have very well developed haustoria but taken together with the general features in the appearance and life-history of the fungus it lends weight to the view that the present fungus falls within the group of the Tilletiaceae.

Of the twelve genera of this group it appears to agree most nearly with Melanotaenium. The fact that the spores are simple and not bound together in balls and that they never lie loose upon the exterior of the plant but only reach the surface by the decay of the tissues of the host plant limits the number of genera to which the fungus may be relegated to three, viz. Schinzia, Entyloma, and Melanotaenium.

In Schinzia (=Entorrhiza, Weber), which is a root parasite, the spores are pale to yellow-brown in colour with a membrane which is rough through the development of wart-like outgrowths. In the fungus at present under consideration the spores are dark brown and quite smooth. It is moreover not strictly a root parasite but appears (so far as the available material allows one to judge) to restrict its attacks to the subterranean stems and leaves.

In Entyloma and Melanotaenium spore development and germination are very similar, the principal difference consisting in

the distribution of the spores in the tissues of the host plant. In Entyloma the spore-masses are limited to small pustular swellings of the leaf or stem whilst in Melanotaenium the spores are spread over a wider area of the host tissues. In Entyloma, moreover, the spores germinate whilst they are still enclosed within the tissues of the host, whilst in Melanotaenium germination only takes place after the decay of these tissues.

In the case of the present fungus the spores are often spread over wide areas of the stem or leaf, whilst with regard to the question of their germination, although, as already mentioned, this has not been actually observed either in the tissues of the host plant or in artificial cultures, yet indirect evidence regarding the situation of their germination is obtained from the following experiments.

A series of inoculations were carried out on 15th May, 1919, in which ungerminated spores derived from completely decayed intumescences were transferred to small wounds made in healthy plants by means of a sterilised scalpel.

Most of these were unsuccessful but in the case of one plant examined on the following September it was found that the characteristic swellings had developed upon the subterranean shoot in close proximity to the point of inoculation. The plant inoculated had been obtained from a district in which the disease was unknown and it was in all respects perfectly healthy. Care had been taken to ensure that the soil in which the plant was grown was uncontaminated.

From these observations it may be concluded that the spores of the fungus do not germinate whilst still within the tissues of the host but only after these tissues have decayed and favourable conditions for germination have been established. It will be seen, therefore, that in both the features which were mentioned above as distinguishing Melanotaenium from Entyloma the present fungus is in agreement with the former genus. The fungus is named and described upon a later page of the present paper (see p. 337).

### *The Genus Melanotaenium.*

The genus Melanotaenium was established by de Bary (1874) who sorted out and rearranged the heterogeneous series of forms which had hitherto been grouped together under the names of Protomyces and Physoderma. Some he retained in these genera and others he referred to Entyloma, whilst one form, discovered by Unger (1833) and named by him *Protomyces endogenus*, he placed in a new genus, Melanotaenium, which he believed, quite correctly, to have its closest affinities with the Ustilagineae. *M. endogenum* is parasitic upon the stems and leaves of various

species of Galium and causes the plants to become curiously dwarfed and blackened. It has a fairly wide distribution in this country having been found as far north as Aberdeenshire (Trail, 1884), whilst examples, preserved in the Kew Herbarium, have been collected at Swanage.

*Protomyces Galii*, Rabenhorst, described by Fuckel (1860) is apparently identical with *Melanotaenium endogenum*. Since this date the following species of Melanotaenium have been described: *M. caulium* Schroeter; *M. cingens* (Beck) Magnus; *M. hypogaeum* (Tul.) Schellenb.; *M. Ari* (Cooke) Lagerheim; *M. Selaginellae* Henn. et Nym.; *M. Jaapii* Magnus; and three doubtful species which have been named *M. Sparganii* Lagerh., *M. maculare* (Wallr.) Cornu, and *M. scirpicolum* Cornu.

With regard to the first of these (*M. caulium*) Schneider in 1871 discovered a fungus growing parasitically upon *Linaria vulgaris* which in an unpublished communication he termed *Ustilago caulium*. In 1881 Beck described a fungus upon the stems and leaves of *Linaria genistifolia* in the neighbourhood of Vienna. This he named *Ustilago cingens*.

De Toni in Saccardo's "Sylloge fungorum" (1888) included this fungus under the name *Cintractia cingens*. Schroeter (1889) in his "Kryptogamenflora von Schlesien" renamed Schneider's fungus *Melanotaenium caulium*. Three years later Magnus (1892) found a fungus growing upon the stems of *Linaria vulgaris* at Bozen which agreed in its characters with the parasite originally discovered by Schneider and also with the one found by Beck upon *L. genistifolia*. As the result of his observations Magnus drew the conclusion that *Ustilago caulium, U. cingens, Cintractia cingens* and *Melanotaenium caulium* were all one species and suggested that this should be named *Melanotaenium cingens* (Beck) Magnus.

There is only a single record of the discovery of this fungus in the British Isles. It was found in 1902 by Mr Theodore Green along the river Dee in the neighbourhood of Llangollen. Specimens of the British plant are preserved in the Kew Herbarium and at the British Museum.

*Melanotaenium hypogaeum* was first described by Tulasne (1851) as *Ustilago hypogaea*. It was found by him in tuberous swellings upon the hypocotyl and upper regions of the root of *Linaria spuria*. Since that time it has been found again by Dr John Lowe in 1869 on the same host in the Isle of Wight as recorded by Phillips and Plowright (1884). It may be mentioned, however, that the specimen is not to be found in Plowright's herbarium. In 1907, Cruchet again met with this fungus at Montagny. A brief account of the fungus was given by Fischer von Waldheim (1877) and again by Schellenberg (1911)

in the "Beiträge zur Kryptogamenflora der Schweiz," who transferred it to the genus Melanotaenium.

*Melanotaenium Ari* was first described by Cooke (1872) under the name of *Protomyces Ari*. It was found by Dr Paxton in May, 1872, upon the leaves and petioles of *Arum maculatum* growing at Chichester. The same fungus was found in Denmark in 1876 by Rostrup who named it *Ustilago plumbea*. Thirteen years later Pirotta (1889) rediscovered this fungus growing upon the leaves of *Biarum tenuifolium* and, believing its affinities to be nearest to de Bary's genus Melanotaenium, he named it *M. plumbeum* (Rostr.) Pirotta. Rostrup in "Ustilagineae Daniae" (1890) accepted this nomenclature. Lagerheim (1899) found the fungus growing upon the leaves of *Arum maculatum* at Pardailhan and he referred to it under the name of *Melanotaenium Ari* (Cooke) Lagerheim. In more recent writings, such, for example, as "Danish Fungi," revised by J. Lind (1913) and Schellenberg's (1911) "Beiträge zur Kryptogamenflora der Schweiz," and also in Jaap's "Fungi Selecti Exsiccata," issued by Magnus in 1903, the name *Melanotaenium Ari* (Cooke) Lagerheim is retained. Through the kindness of Miss Wakefield and Mr J. Ramsbottom I have been enabled to re-examine Cooke's original type-material of this fungus as well as other specimens collected elsewhere at various times. I find the spores to be quite different in character from those of either *Protomyces* or of any member of the Ustilaginaceae. Their membrane is comparatively pale in colour and is more complex in structure than is the case with that of either of these groups. It consists of an inner layer (endospore) and a comparatively thick outer coat (exospore) which swells up vigorously in strong sulphuric acid. Moreover, the outer coat is perforated by several narrow germpores. It was not found possible to determine more nearly the details of the structure of this fungus or its spores in herbarium specimens, and the true systematic position of the fungus must be left undecided until fresh material becomes available.

*M. Selaginellae* Henn. et Nym. (Hennings 1900) was found in Java growing upon the stem and bases of the leaves of Selaginella. Its spores are chestnut brown in colour and later black; their membrane is covered with wart-like outgrowths and they measure 17–19$\mu$ in diameter.

*M. Jaapii* Magn. was found by Jaap in 1911 near Vienna growing upon *Teucrium montanum*, and a short description of this fungus was given by Magnus (1911) in the same year. It forms swellings upon the base of the stem or the upper region of the root and in one case it was found to occur higher up the stem of the plant. In sections it could be seen that the hyphae of the fungus run in the intercellular spaces and send haustoria

into the surrounding cells. The spores, which are formed intercalarily upon the hyphae, are dark brown and possess a thick, firm, smooth membrane. The mature spores measure about 22–23·3$\mu$ across their longest diameter. Often they are completely spherical but at other times they may measure 23·3 × 20·6$\mu$, 23·3 × 19·2$\mu$, or even 22·3 × 17·8$\mu$ across their longest and shortest diameters respectively.

Besides the species mentioned above there are three others which have provisionally been placed under Melanotaenium but probably belong elsewhere. Of these, one is *M. Sparganii* which grows upon the leaves of Sparganium and possesses spores measuring 10–16 × 9–10$\mu$ in diameter and which are yellow-brown in colour. It was first described by Lagerheim (1899) and is probably more correctly to be referred to the Chytridiaceae.

Another doubtful form is *M. maculare* (Wallr.) Cornu. This occurs within the epidermal cells of the leaves of *Alisma ranunculoides* var. *repens*, and was first described by Wallroth as *Physoderma maculare* and provisionally referred to Melanotaenium by Cornu (1883). It forms small black spots upon the leaf but produces no swelling or hypertrophy of the tissues. This is almost certainly not a Melanotaenium and Wallroth's original name may be retained for it.

A third form which has been dubiously included under Melanotaenium by Cornu (1883) is *M. scirpicolum* Cornu. This occurs upon the rhizome of *Scirpus lacustris*. Its spores are ovoid, pale brown in colour and measure 28–32 × 18–20$\mu$ in diameter.

The foregoing appears to be a complete list of all the species of Melanotaenium which have hitherto been described and it remains to see what relationship the parasite upon *Lamium album* bears towards them.

| Species | Host | Spore measurement |
|---|---|---|
| *M. cingens* (Beck) Magnus (Syn. *M. caulium* Schr.) | Stems and leaves of *Linaria vulgaris* and *L. genistifolia* | 12–18$\mu$ |
| *M. hypogaeum* (Tul.) Schellenberg | Hypocotyl and root of *Linaria spuria* | 14–22$\mu$ |
| *M. endogenum* (Unger) de Bary | Stems and leaves of *Galium* spp. | 16–22$\mu$ |
| (*M. Ari* (Cooke) Lagerheim | Leaves and petioles of *Arum maculatum* | 14–16$\mu$) |
| *M. Selaginellae* Henn. et Nym. | Stem and leaf bases of *Selaginella* | 17–19$\mu$ |
| *M. Jaapii* Magnus | Stem and root of *Teucrium montanum* | 17·8–23$\mu$ |
| *M. Lamii*, sp. nov. | Subterranean stems and buds of *Lamium album* | 17–20$\mu$ |

The points in which the species are differentiated from one another are very slight and dependence has been chiefly placed

upon the size of the spores and upon the host plant which they attack. Omitting the doubtful forms the most important facts regarding the known species are briefly summarised in the above table.

From what has been said above, it will be recognised how slight are the morphological features which distinguish the species of Melanotaenium from one another. No doubt a more complete knowledge of the germination, development and cytology of the different forms would reveal other characters which would differentiate them morphologically rather more sharply from one another. In the meanwhile we must admit the total inadequacy of the existing morphological criteria for this purpose.

The slight differences observed in the dimensions of the spores of the various forms may quite possibly be due, partly to dissimilar conditions under which development has taken place, and partly to the personal equation which inevitably enters into the case when a number of different observers measure a comparatively small number of selected spores with different instruments.

The conclusion to which these remarks trend is that in the Melanotaeniums, as indeed in the Smuts in general, the "species conception" can only be used as a convenient means of separating the several forms which occur upon different host plants. It can have here even less significance, as a hard and fast morphological distinction between natural entities, than is the case with the more highly differentiated organisms in which several investigators, such as Klebs, Goebel and Brierley, have shown that the various morphological characters are merely the expression of the interaction between two factors: the internal, molecular constitution of the protoplasm upon the one hand and the external environment upon the other, and that if either of these factors vary the morphological characters may become changed. Based upon its occurrence upon a new host plant, I therefore consider it advisable, provisionally at any rate, to regard the Melanotaenium which has been found upon *Lamium album* as a new species (in the above sense) and would suggest for it the name *Melanotaenium Lamii* sp. nov.

### Melanotaenium Lamii sp. nov.*

The fungus forms intumescences or tuber-like swellings upon the subterranean stems and buds of *Lamium album*. Spore mass

* *Melanotaenium Lamii* sp. nov.

Sori atri; sporae globosae vel ovatae, 17–20$\mu$ diam., episporio crasso, glabro, atro-brunneo tectae, per matricis putrefactionem liberatae. Sporarum germinatio non visa. Sporae hyphaeque totam matricem penetrantes intercellulares, mycelium haustoriis praeditum. In caulibus gemmisque subterraneis *Lamii albi*, tubercula forma variis ad 8–9 cm. diam. efficiens.

black, liberated by the decay of the host tissue. Spores spherical to oval, measuring 17–20$\mu$ in diameter. Spore-membrane thick, smooth, dark brown. Germination of spores not observed. The spores and hyphae occur in the cortex and pith of the host plant and are also frequently found in vascular tissue. Hyphae forming pseudo-parenchymatous masses in the intercellular spaces of host. Host plant *Lamium album.* Found at Chalfont, Stroud, Gloucestershire, by Mr W. F. Drew.

### *Morphology and Cytology of* M. Lamii *and comparison with other Genera.*

Such features in the morphology and cytology of the fungus as the small amount of the material available permitted to be ascertained will now be described. The hyphae of the fungus run between the cells of the host plant and at the intercellular spaces they often become massed, closely interwoven, and frequently septate so that they form a pseudo-parenchymatous body at these spots (fig. 2).

Haustoria are developed at numerous points and these penetrate the cell wall and form much branched, coralloid structures within the host cell (figs. 5 and 10). They usually attain a considerable size and form a conspicuous feature in the morphology of the fungus. They resemble a bunch of grapes in form, and are seen to consist of a series of very short branchlets which arise from the apex of a common carrying thread and each of which is dichotomously forked at its end (fig. 6). The main thread of the haustorium arises as an ordinary lateral branch from one of the intercellular hyphae. No appressorium could be seen such as Lutman (1910) described in *Entyloma Nymphaeae* (Cunn.) Setch.

Lutman also found in his plant that the host cell nucleus frequently becomes enclosed in a tangled knot formed of the haustorial branches. In *Melanotaenium Lamii* the terminal branchlets of the haustorium have several times been observed to be closely applied to the nucleus of the host plant so that this body becomes partly enveloped by them (fig. 5) but this is not a constant feature, and just as many cases can be observed in which the haustorium and cell nucleus remain widely separated from one another (fig. 10) as those in which a closer relationship is established between them.

In spite of a number of works on the subject our knowledge of the cytology of the Ustilagineae is still very incomplete. Not only is the available information about any of the genera of this family contradictory but many genera have never been investigated at all. The genus Melanotaenium is among the latter and the few facts ascertained and described below may form the

starting-point for a more complete account when more abundant material becomes available.

With regard to the nucleus of Ustilagineae the following is a summary of work already carried out. The earliest paper of importance is that by Dangeard (1892). He examined *Ustilago Tragopogi, U. Carbo, U. violacea, Doassansia Alismatis, Entyloma Glaucii, Urocystis Violae,* and *Tilletia Caries,* and found that the spore-bearing hyphae and the young spores are always bi-nucleate.

In 1899 Harper (1899) confirmed Dangeard's results, working on *Ustilago Carbo, U. Maydis, U. antherarum,* and *U. Scabiosae.* Federley (1904) for the first time observed a passage of the nucleus from one conidium to the other during the conjugation of these bodies in *Ustilago Tragopogonis-pratensis* Pers. He believed that these nuclei fused at once and that a bi-nucleate stage of the hyphae and spores did not occur in this plant.

Six years later Lutman (1910) published the result of his investigations on *Ustilago laevis, U. Zeae, Urocystis Anemones, Doassansia Alismatis* and *Entyloma Nymphaeae.* He observed in *Ustilago laevis* that the conidia are uni-nucleate and that during conjugation the nucleus and most of the cytoplasm of one spore migrate into the other one. The mycelial cells in the host plant were found all to be bi- or multi-nucleate. During the development of the spores the two nuclei fuse so that the mature spore is uni-nucleate.

In 1912 and 1914 Rawitscher gave an account of the cytology of *Ustilago Tragopogonis, U. Maydis* and *U. Carbo.* In *U. Tragopogonis-pratensis* Pers. he found that the hyphae and young spores are bi-nucleate whilst the mature spore is uni-nucleate. The pro-mycelial cells and the conidia are uni-nucleate. In *U. Maydis* Corda the cells of the hyphae are uni-nucleate until just before spore-formation when the cell contents of two adjacent cells become fused with one another through the resorption of the membrane previously separating them from one another. Bi-nucleate spore rudiments are thus established. The two nuclei fuse and uni-nucleate spores result. The conidia are uni-nucleate.

In the case of *U. Carbo* it is either the cells of the uni-nucleate mycelium or the uni-nucleate sporidia themselves which may conjugate with one another and give rise to bi-nucleate cells. The young spores are bi-nucleate and the mature ones uni-nucleate.

In the case of *Tilletia Tritici* Rawitscher also found that the sporidia copulate in pairs and, upon their germination, give rise to bi-nucleate hyphae.

Werth and Ludwig (1912) came to very different conclusions

in their examination of *Ustilago antherarum* Fr. They found neither a fusion of two nuclei in the spores nor the migration of one cell nucleus into the other cell during the anastomotic union between the two sporidia.

In 1915 Wilson (1915) published a short account of his work upon the cytology of *Tubercinia primulicola*. He found the cells of the mycelium to be uni-nucleate, as are also the conidia which arise from it. The conidia conjugate in pairs and the nucleus of one passes through the connecting bridge into the other, giving rise to a bi-nucleate structure. The chlamydospores are formed in coils of hyphae which are bi-nucleate and which have most probably developed from the fusion-product of the two conjugating conidia. The spores are at first bi-nucleate but subsequently the two nuclei fuse and the mature spore is uni-nucleate.

Paravicini (1917) published an important contribution to the subject. He investigated the seven species into which the collective species *Ustilago Carbo* has now been divided as well as a number of other species including *Tilletia Tritici* (Bjerk.) Wint., *Entyloma Calendulae* (Oud.) de Bary, *Urocystis Anemones* (Pers.) Wint., and *Urocystis Violae* (Sow.) Fisch. v. Wald. In all cases he found the promycelial cells and the conidia to be uni-nucleate. Where the conidia conjugate with one another there is a passage of the nucleus from one spore to the other so that a bi-nucleate conidium results. In those cases, such as *U. Tritici* and *U. nuda*, in which no conidia are formed, the cells of the mycelium conjugate with one another and bi-nucleate cells are established by the migration of the nucleus from one cell to the other. The spores are bi-nucleate and the two nuclei fuse so that the mature spore is uni-nucleate.

No work has hitherto been done upon the cytology of the genus Melanotaenium. In the case of *M. Lamii* it was found to be a matter of considerable difficulty to ascertain the number of nuclei in the cells of the hyphae. These hyphae are usually exceedingly fine and their walls, especially the septa, stain very faintly with the dyes used. In the few favourable cases in which both the hyphal walls and the nuclei were satisfactorily stained two nuclei were present in each cell and it is most probable that this is the constant number in the cells of these hyphae (fig. 8).

The young haustoria are filled with dense cytoplasm and contain two nuclei in each of the terminal branchlets, one lying in each fork of the branchlet. It was not possible to determine whether the branchlet is cut off from the main branch by a septum, but if this should prove to be the case we have here the bi-nucleate condition of the cells maintained in the haustorial apparatus.

The spores are developed intercalarily upon the hyphae which form the pseudo-parenchymatous masses. The youngest spores observed measured 10 × 6$\mu$ in diameter (fig. 4). Spores at this stage were seen to be unmistakably bi-nucleate and it was found that the bi-nucleate condition was maintained in the spore until quite shortly before maturity (fig. 7). The mature spore is uni-nucleate (figs. 8 and 9), presumably through the fusion of the two nuclei which exist during the earlier stages, but the actual fusion was not observed. The single nucleus of the later stages is, however, much larger in size than either of the nuclei which occur in the bi-nucleate stage and this probably indicates that it has arisen through the union of the two smaller nuclei.

It may be mentioned here that spores in the most various stages of development may occur close together within one pseudo-parenchymatous mass of hyphae. Thus in fig. 3 a mature spore containing a single nucleus occurs side by side with a much younger one which is still bi-nucleate.

The spore-membrane itself is apparently single and no success was obtained in attempting to demonstrate any lamination in it or in revealing the presence of an endospore in any of the spores which were examined*.

It will be seen from this brief account that the mature spore of Melanotaenium is uni-nucleate whilst the hyphal cells and the young spores are bi-nucleate. As germination of the spores of *M. Lamii* was not obtained it is not possible to say definitely where the transition between the uni-nucleate and the bi-nucleate stages occurs, but it may be pointed out that Woronin (1881) in his study of *M. endogenum* observed numerous cases of the germination of the spores and found the conidia conjugating with one another. It is not improbable that this is the point in the life history of the fungus at which, by the passage of the nucleus from one conidium to the other, it attains the bi-nucleate condition.

I should like here to express my great indebtedness to Miss Wakefield for her kind assistance throughout in the preparation of this paper.

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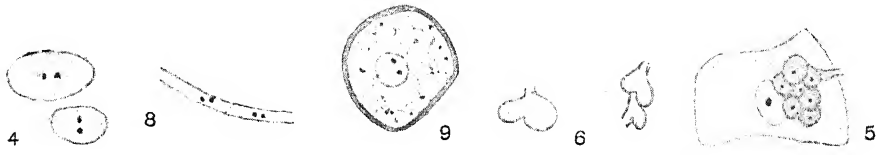


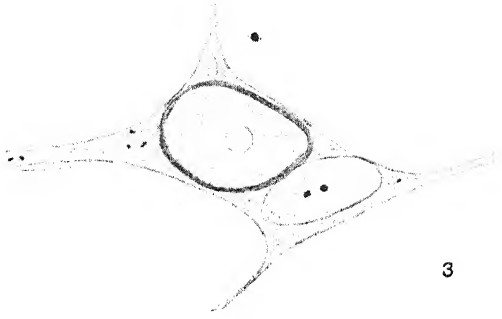


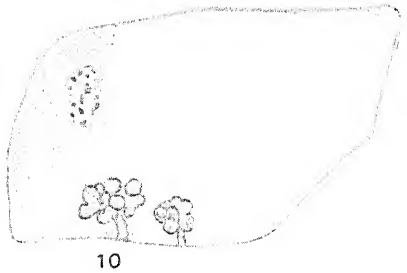


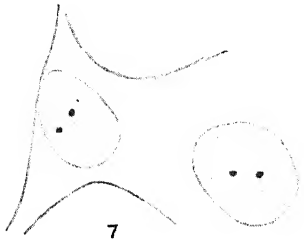



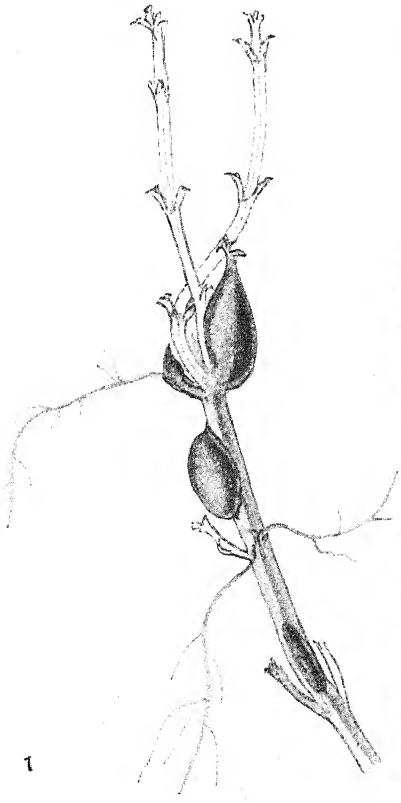


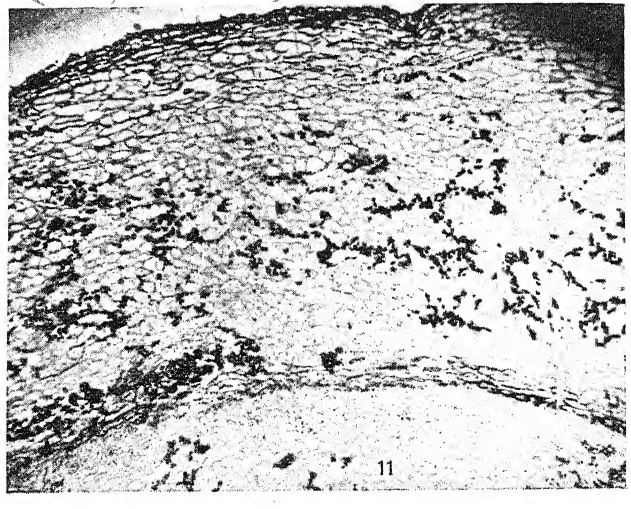


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## EXPLANATION OF PLATE VIII

Fig.

1. Rhizome of *Lamium album* with swellings caused by *Melanotaenium Lamii*.
2. Mycelium forming pseudo-parenchymatous mass in an intercellular space of host plant. × 1000.
3. Spores of *M. Lamii*; one young, the other mature. × 1000.
4. Very young spores of *M. Lamii*. × 1000.
5. Haustorium of *M. Lamii*, partly enveloping host nucleus. × 1000.
6. Dichotomously branched terminal branchlets of haustorium. × 1000.
7. Young bi-nucleate spores of *M. Lamii*. × 1000.
8. Bi-nucleate hypha of *M. Lamii*. × 1000.
9. Mature uni-nucleate spore of *M. Lamii*. × 1000.
10. Two haustoria of *M. Lamii* within a bi-nucleate cell of host plant. × 1000.
11. Section of an intumescence upon a subterranean stem of *Lamium album* showing distribution of the spores of *M. Lamii* within its tissues. From a microphotograph.

# NOTE ON MARASMIUS CAUTICINALIS (WITH.) FR.

*By the Very Rev. David Paul, LL.D., D.D.*

There would appear to be some question as to the orthography of the specific name of this Fungus. Fries quotes it as Withering's name, but apparently the plant was not known to Withering, and the name does not occur in his Arrangement of British Plants, 1796. Other authors—Quélet (Fl. Myc. p. 322) and Bigeard and Guillemin (Champ. supér. de France, II, 152)—follow Fries in this attribution of the name, seemingly without investigation. Fries also quotes Sowerby, and cites his Plate 163, but Sowerby spells the word *caulicinalis*, not *cauticinalis*. The same spelling is found in Swartz (Vet. Ak. Handl. 1808, p. 82) and in Secretan (Myc. Suisse, 1833, n. 838)—both quoted by Fries in connection with this Fungus. Fries himself (Syst. Myc. 1821, I, p. 167, under *Ag. campanella*) began by spelling the word *caulicinalis*. In his Mon. Hym. II, 227 (1863), however, he writes *Marasmius cauticinalis*, and says, "This seems to be the *caulicinalis* of Sow., and is certainly that of Swartz," making no reference to the fact that both these authors spelled the word differently. Finally, in his Hym. Eur. p. 476, he adheres to the new spelling of the Monographia which is followed by Quélet and the authors of the Flore des Champignons supérieurs de France.

So much for the history of the word as applied to this Fungus. How did the change in spelling come about? Some light may be thrown on the subject by tracing the history of another Fungus-name, that of *Ag. cauticinalis* Bull., given by Fries as a synonym of *Ag.* (*Coll.*) *stipitarius* in Hym. Eur. p. 117. Originally, as in the other case, he spelled the word *caulicinalis* (Syst. Myc. I, 138; Mon. Hym. I, 158). This is also Bulliard's own spelling (tab. 522, fig. 1), followed by Sowerby (fig. 163), and by Berkeley (Smith's Eng. Flora, V, 54). Quélet (Fl. Myc. p. 315) refuses to follow Fries' alteration, and describes the Fungus as *Marasmius caulicinalis* Bull., and Secretan (Myc. Suisse, n. 740, II, 176) adopts the same orthography. It is significant too that Dr Robert Fries, son of Elias Fries, in his Synopsis Hymenomycetum Regionis Gothoburgensis, 1888, instead of adopting his father's name of *Ag.* (*Coll.*) *stipitarius* for this

Fungus, calls it *Ag.* (*Coll.*) *caulicinalis* Bull., adding: "Denuo recepi nomen Bulliardi, cujus icon accurata." So Krok and Almquist in their Svensk Flora för Skolor, Stockholm, 1907, II, 248, call this Fungus *Mar. caulicinalis*, notwithstanding the fact that all Swedish botanists hold Fries and his nomenclature in supreme honour and reverence. Also, the Flore des Champignons supér. de France describes the Fungus under the name of *Mar. caulicinalis* Bull.

Originally, then, the specific name *cauticinalis* was not applied by any one, not even by Fries, to either of these Fungi. It cannot be said that he introduced the new spelling to avoid confusion, for from the outset he had named the one Fungus, *Ag.* (*Coll.*) *stipitarius*, and no confusion would have been caused by retaining the specific name *caulicinalis* for the other. It is possible that the change from *l* to *t* arose from inadvertence on Fries' part, or from an uncorrected printer's error. One can only conjecture. At any rate it would appear to the writer that, while the specific name *stipitaria* Fr. is retained for the *Collybia* of Bulliard*, the *Marasmius* of Sowerby and Swartz should have the name *caulicinalis* restored to it in accordance with the International Rules for naming Fungi.

It only remains to be said that *caulicinalis* is a well-chosen name to indicate the habitat of either Fungus, whereas in regard to neither of them has *cauticinalis* any point or significance. The former means "growing on stalks, stems, straws or such-like," and the latter "growing on or among rocks." While almost any Fungus may be found growing near rocks it is hardly possible to think that Fries, so admirable in his selection of specific names, could have deliberately chosen *cauticinalis* for either Fungus.

* Dr Paul is in error in assuming that the *Agaricus caulicinalis* Bull. is now considered identical with the *Agaricus* (*Collybia*) *stipitarius* Fr. Quélet in Fl. Myc. de Fr. 315 distinguishes *Marasmius caulicinalis* (Bull.) Quél. from *Marasmius scabellus* (A. & S.) Quél. and makes the *Agaricus stipitarius* of Fries synonymous with the latter. I have also set out the distinctions between these two species in my definition of *Crinipellis caulicinalis* (Bull.) Rea in Trans. Brit. Myc. Soc. v, 436. C.R.

## A NEW DISCINELLA.

*By W. D. Buckley.*

While searching for Discomycetes during the favourable conditions of the early Spring a gathering was made of some specimens among moss, under Ulex, suggesting at first sight a pale Humaria. Further gatherings produced apothecia in every stage of development and made it possible to identify a new species of Discinella, *D. margarita*. The genus Discinella was founded by Boudier in his Nouvelle Classification Naturelle des Discomycètes Charnus in Bull. Soc. Myc. Fr. 1885, 1, p. 112, *Phialea Boudieri* Quél. being made the type of the genus. The generic characters were further amplified in his Histoire et Classification des Discomycètes d'Europe (1907) and as pointed out by Ramsbottom in Journ. Bot. (1914), p. 215, consist of the terrestrial habit and the size of the fungus which may reach 12 mm.; the apothecia being thick and more or less subtomentose; the inoperculate, exceptionally small asci, with marginate pore, and the slender paraphyses filled with oil globules. The spores are fusiform and guttulate with or without granulations. (Karsten's genus Discinella is not identical with Boudier's "est Discina Fr. cm apotheciis minoribus" (Hedwigia, 1891, 30, p. 301). *D. corticalis* the type is found on wood.) The number of species in the genus does not exceed seven (with possibly two synonyms) five of which have been recorded for Britain. The species of this genus are placed by Saccardo in Humaria. The present species approximates most closely in general characters to *D. Menziesi* Boud., described and figured in Brit. Mycol. Soc. Trans. 1913, IV, p. 62, as *Calycella Menziesi*. Boudier himself corrected this and assigned the fungus to its true position as a Discinella in Tom. cit. p. 323. (The specific name was misspelled as "Meuriesi" Boud. in Bull. Soc. Mycol. Fr. XXXIII, p. 17, 1917.)

Although *D. Menziesi* and the present species have points of resemblance they are very distinct plants: the latter is smaller and is marked by its pearl-grey colour especially when young, with a remote touch of pink, as contrasted with the pronounced rose colour of the former. In the many specimens of *D. margarita* examined none exceeded 1½–2 mm. The stipe was never prominent as it often is in *D. Menziesi*, the specimens never being more than turbinate. It is slightly furfuraceous on the outside, the cells of the excipulum running out into patchy bundles of short irregular hyphae. The asci are intermediate in size between those of *D. Menziesi* and *D. minutissima*. The paraphyses are filiform about 1$\mu$ broad and frequently strongly

branched at varying distances from the base, sometimes subdichotomously and at others on one side only and often presenting a budding appearance; the apices are at times slightly thickened and shortly and acutely bent, but this is not the normal condition. They contain oil globules and granulations which give a pseudo-septate appearance. The excipulum shows signs of separate hyphae at the base, passing into a pseudo-parenchymatous condition of irregular cells of greatly varying size and form, becoming very small and compacted at the margin; the hypothecium is finely cellular. The three species, *Menziesi*, *minutissima* and *margarita* fall into a natural group, being characterised by a more or less intense shade of pink combined with white or grey, whereas the other species of the genus show some marked shade of purple or brown. The affinity indicated is natural and more easily recognised than expressed. The specimens were accompanied by *Helotium luteolum* Currey (*Dasyscypha lutcola* (Curr.) Sacc.) which also occurred on Ulex stumps.

My thanks are due to Mr Ramsbottom of the British Museum for much help in the preparation of this note.

DISCINELLA MARGARITA.

Gregaria, minutissima ad 2 mm. lata, turbinata, crassa, margaritaceo-grisea roseolo-tincta; carnosa, margine integro; primo concava mox applanata. Paraphysibus tenuibus circa 1$\mu$ crassis, oleosis, filiformibus, simplicibus aut ramosis, ad apices non aut vix incrassatis, hyalinis, non-septatis. Ascis modicis 70–80$\mu$ longis × 9–10$\mu$ latis, inoperculatis, octosporis, foramine marginato, cylindrico-clavatis ad basim vix attenuatis, ad apicem iodo non caerulescentibus. Sporis fusiformibus, hyalinis, levibus, continuis, saepe leniter curvatis, 9–15$\mu$ longis × 3–4$\mu$ crassis, intus guttulosis, et granulosis; guttulis 2–5 plerumque, granulis minoribus.

Ad terram argillosam inter muscos, Slough, May 1920.

DISCINELLA MARGARITA.

Gregarious, up to 2 mm. broad, turbinate, thick, pearl grey with a tinge of flesh colour; fleshy, margin entire. At first concave then convex and spread out. Paraphyses filiform, simple or branched, apex slightly or not at all thickened, hyaline non-septate, containing oil drops. Asci medium size 70–80$\mu$ long by 9–10$\mu$ broad, inoperculate, 8-spored, opening marginate, cylindric-clavate, slightly attenuated at the base, not coloured blue with iodine. Spores fusiform smooth, continuous, sometimes curved on one side 9–15$\mu$ long by 3–4$\mu$ broad, 2–5-guttulate with granules.

On the ground among moss under *Ulex*, Slough, May 1920.

# ON THE BIOLOGY OF PANUS STYPTICUS.

With Plate IX.

*By Marie E. M. Johnson.*

*Panus stypticus* Fr., so called because of its remarkable astringent taste, is found on old logs of fir, alder, beech, oak, hazel, birch, chestnut, etc. throughout the year. It grows best in damp situations, but too much moisture is injurious. When a log infected with this fungus was brought into a garden in the vicinity of some iron and chemical works, the sporophores became discoloured, lost their usual fresh appearance, and generally became unhealthy; the young sporophores almost ceased to grow, and no new ones appeared, although the log was continually moistened. The smoky atmosphere, sometimes charged with poisonous gases, was evidently quite unsuitable for its growth. It seemed at first as if the damage were due to frost, rather than to the unsuitable black-country atmosphere, but even when the log was kept in a more sheltered situation, and covered up during severe frosty nights, no new sporophores appeared, suggesting that frost could not have been the sole cause of their non-appearance, though it may have been the cause of a retardation of growth. Later, when the infected log was removed to a clearer atmosphere, young fresh-looking sporophores quickly appeared. Moreover, a large piece of wood, which had previously been broken off from this infected log and kept in a country district, produced sporophores which were unaffected by frost.

*Panus stypticus* is one of the many fungi eaten by slugs, which on discovering the whereabouts of an infected log, cause the rapid disappearance of young sporophores and bite large pieces out of mature ones, leaving only their slimy trail to account for the damage. It is possible that slugs may be active agents in the dispersal or even the germination of the spores.

*Spores and their Germination in Hanging Drop Cultures.* The spores are colourless, oval, and apiculate, having a size of $4\mu \times 3\mu$. They germinate readily in rain-water, 5 per cent. glucose, 10 per cent. gelatine, malt-wort extract, and various other media, and even spores which had been dried for five days in the atmosphere of the laboratory germinated after 20 hours.

Bacteria are said to assist germination but according to observations made on hanging drop cultures, their presence was not beneficial to the germination of these spores.

*Wood Block Cultures.* Small pieces of sterilised wood infected with basidiospores in an infection chamber, were placed in glass cylinders (7 inches long) and plugged with cotton wool which

was continually absorbing moisture. The cultures were placed in sets of three in large sterilised closed glass vessels. In about 12 days mycelium appeared which grew especially well on silver birch. After 5 weeks' growth, the cultures were removed to larger vessels and placed under similar conditions of light and moisture. Growth was then more rapid and within three weeks young sporophores appeared. Bayliss* also observed that an increased supply of air had a beneficial effect upon wood block cultures of *Polystictus versicolor* and this was followed by the production of small sporophores, but since then she obtained in less than eight months well developed sporophores of *Polystictus versicolor*† by using large instead of small sterile blocks of wood kept under good conditions of aeration and humidity.

Oidia were observed only in hanging drop cultures.

*Destruction of Wood.* The growth of the mycelial strands, which interlace in the vessels, wood fibres and medullary rays, causes the wood to become light, very soft and paler in colour.

Sections showed that the more highly lignified elements persisted the longer (fig. 1*b*) while the less lignified spring elements were the first to disappear (fig. 1*a*). In some cases the secondary thickening of the cells is first absorbed, the middle lamella persisting (fig. 1*a*) but finally this is removed also. In other cases the hyphae have penetrated straight through a cell wall, the middle lamella having been dissolved at the same time as the other part of the cell wall (fig. 1*a*). Sometimes the hyphae pass from tracheid to tracheid *via* the bordered pits. In the autumn wood and medullary ray cells, the pits become enlarged (fig. 1*b*).

*The Sporophore.* This first appears as a tiny white knob about $\frac{1}{8}$th of a cu. mm. in size (fig. 2). Within one or two days this tiny white knob grows into a horizontal pyramidal mass about $1\frac{3}{4}$ mm. in height (fig. 2*a*), increase in elevation being due to elongation of the contained hyphae. Soon a tiny pileus can be recognised (figs. 2*b'* and 2*b*), and the stipe lengthens; sometimes the latter is only about 1 mm. in length when the pileus first appears. The hyphae of the stipe gradually cease to grow terminally and then commence to branch, many of the branches following a horizontal direction, giving rise to the pileus. This is indicated by the flattening and broadening out of the apex of the stipe (fig. 4*b*). These horizontal hyphae give off vertical branches which remain more or less parallel, and finally cease to grow, and so give rise to the dorsal tissue of the pileus. Other similar branches are given off which turn downwards and form the hymenium, which can be seen when the pileus is about $2\frac{1}{2}$ mm. across (figs. 4*c*, 2*c'*, 2*c*). The young pileus is globose and

* Jessie S. Bayliss, The Biology of Polystictus versicolor, Journal of Economic Biology, III, 1908. † An unpublished statement.

its growth is at first epinastic, its margin being incurved and pressed against the stipe (fig. 4*b*). Thus the hymenium begins to be formed within a special chamber. As the hymenial surface increases and keeps pace with the growth of the dorsal tissue of the pileus, the latter expands and exposes the gills (figs. 4*c*, 2*d'*, and 2*d*). The gills are formed by the continual downward growth of some of the hyphae; these bend outwards and bear the elements of the hymenium. The gills are thus exposed before the pileus is completely developed and before the spores are mature. Spores can be obtained from sporophores, which are about half an inch across, and liberation of the spores continues until the sporophore is fully grown—a period of a month or two. The mature spores are disseminated by the wind. When the sporophore is nearing maturity, some of the terminal portions of the hyphae of the dorsal surface separate, and thus the upper surface of the sporophore becomes granular in appearance.

The free margin of each gill is fringed by a number of cystidia, some being club-shaped, while others are pointed and some bear tiny branches (fig. 3). Among the basidia are occasionally seen cystidia (figs. *7a* and *7b*), which resemble some of those fringing the free margin of the gills; they are colourless and project out beyond the basidia.

With variations of temperature and moisture there is a variation in the amount of growth of the pileus, but under moderately favourable conditions a sporophore takes about three months to develop. An insufficient supply of air delays growth.

The sporophore projects out horizontally from the substratum (fig. 4*d*). If the position of a log is altered after young sporophores with the beginnings of gills have appeared, the stipes of these attempt to readjust themselves in order to place the pileus in a horizontal position.

The pilei are sometimes zoned and this depends on changes in the humidity of the atmosphere, variations in the amount of moisture causing alternate acceleration or retardation of growth.

The yellowish-brown pigment is diffused through the cell sap of the hyphae and is much deeper in colour just below the cuticle of the pileus. In very young sporophores stipes and pilei are very pale buff, but soon the colour of the pilei deepens and subsequently becomes cinnamon. Intensity of colouring appears dependent on light, for when sporophores are grown in diffuse light (temperature and humidity being constant) they are a uniform pale buff colour but in bright light cinnamon or tan.

According to Atkinson*, the young sporophores of *Panus stypticus* are phosphorescent, but no fruit bodies which were examined exhibited this phenomenon.

* G. F. Atkinson, Mushrooms, p. 136.

*Reactions of Sporophores to* (*a*) *Light.* Logs bearing young sporophores having an average height of about 2 mm. were kept in darkness for four months under suitable conditions of humidity. At the end of this period examination showed no increase in the size of the fruit bodies, in fact some had become smaller and looked very withered. The majority of the fruit bodies were about one and a half mm. in height and had developed no pilei; others had a stipe of about 2 mm. in length and a pileus about half a mm. across. Even in partial darkness the sporophores which appeared had abnormal stipes and small or no pilei. Yet darkness appeared to favour the growth of mycelium.

(*b*) *Gravity.* A branch bearing a few small fruit bodies was attached to a clock clinostat and rotated on a horizontal axis, a continuous and constant supply of moisture for the fruit bodies being arranged: a control experiment was kept. The branch on the clinostat was rotated once every 20 minutes. For four months the experiment was continued but normal sporophores were never formed. New tiny pyramidal masses appeared which quite quickly developed pilei: the stipes of these fruit bodies were shorter in comparison with the breadth of the pilei than on normally grown fruit bodies; gills soon appeared and the sporophores matured quickly. Some of the stipes became curiously swollen and without exception the fruit bodies expanded their pilei at right angles to the axis of revolution so that the gills developed horizontally instead of assuming the normal vertical position (fig. 5).

Thus it appears that both light and gravity influence the development of the sporophores.

*Panus stypticus* is a xerophytic fungus, for sporophores after being dried for six months or longer will revive when moistened and shoot off spores capable of germination.

The mycelium also of this fungus retains its vitality after receiving little or no moisture for many months.

In conclusion I wish to express my thanks to Dr Jessie S. Bayliss Elliott for the valuable assistance she has given me in many ways during the course of this study.

## SUMMARY.

1. The sporophores of *Panus stypticus* can withstand frost and so can be cultivated out of doors in winter months. A sporophore takes about three months in developing.

2. The spores germinate readily in suitable media, and wood block cultures when given a favourable supply of light and moisture produce sporophores in the course of six or seven weeks.

3. Wood when attacked by this fungus becomes light, very soft and paler in colour. The less lignified spring elements are the first to disappear.

4. Sporophores of this fungus which have been dried for a considerable time when moistened shed spores which will germinate, moreover the mycelium can be dried for many months and still retains its vitality.

## EXPLANATION OF PLATE IX.

Fig.

1. Transverse section to show the effect of the mycelium of *Panus stypticus* upon the wood of alder. "*a*" shows the more rapid destruction of the spring wood, while "*b*" shows the destruction of the more persistent autumn wood, both drawings being taken from the same section. × 534.

   *a*. The destruction of the less lignified fibres is shown in the regions "*c*," "*d*," and "*e*," while the medullary rays and more highly lignified elements near "*f*" are seen to be more persistent. "*g*" are walls which have been practically consumed except for the middle lamella. Removal of secondary thickening and later of the middle lamella is represented at "*h*," "*i*" shows a hypha penetrating through a cell wall, the middle lamella having been dissolved at the same time as the other part of the cell wall. At "*n*" secondary thickening and middle lamella have been removed. × 534.

   *b*. Near "*j*" can be seen the enlargement of the pits, which takes place in the autumn wood cells. At "*k*" are elements which have lost some of their secondary thickening. × 534.

2. "*a*," "*b*," "*c*," "*d*," and "*e*" are successive stages in the development of the sporophore—ventral views. "*a'*," "*c'*," "*d'*" and "*e'*" are lateral views natural size.

3. Cystidia found at the free margin of the gills. × 534.

4. *a*, *b*, *c*, longitudinal sections through young fruit bodies.

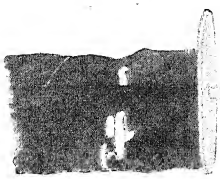
5. This figure shows sporophores which have developed upon wood fixed horizontally to a clinostat; the pilei of the fruit bodies have expanded vertically. Sporophores are about natural size.

6. Abnormal sporophores which have developed in a dark position in the laboratory. Natural size.

7. Section through hymenium. × 534.

   *a*. Basidia and attachment of basidio-spores. Figure also shows cystidia. × 534.

   *b*. Shows a cystidium with a pointed end. × 534.



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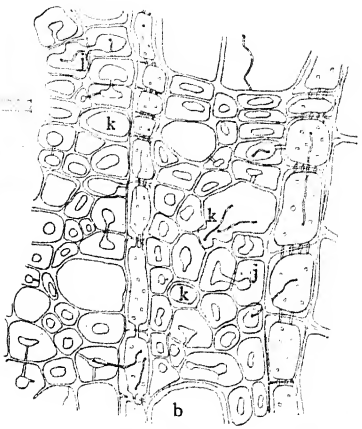


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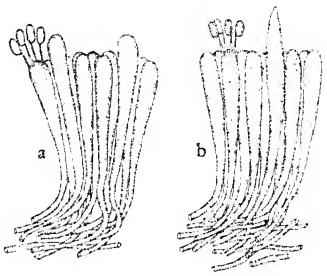


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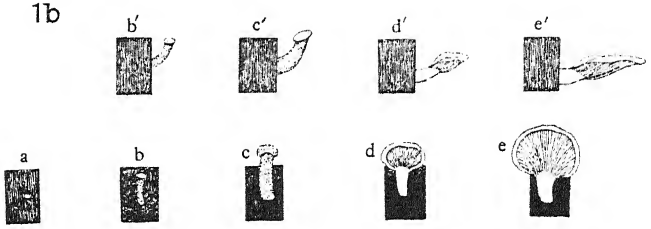


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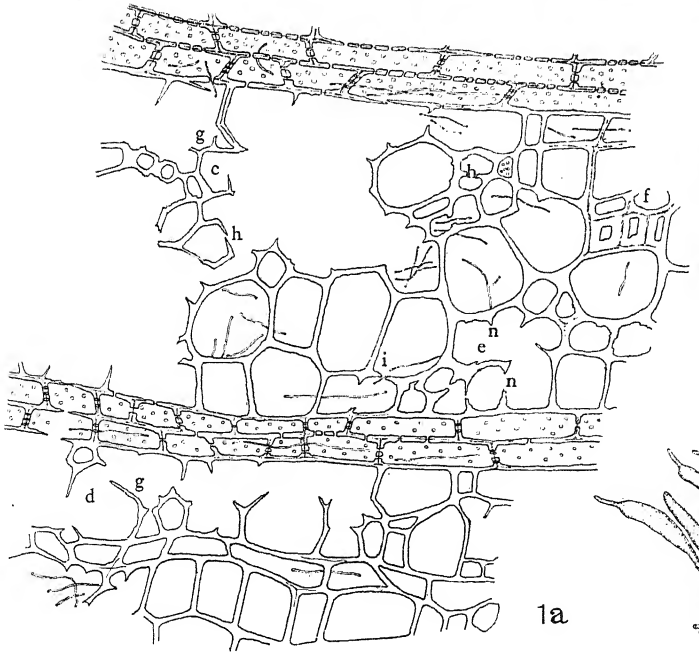


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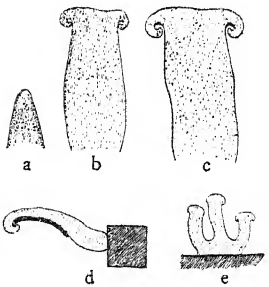


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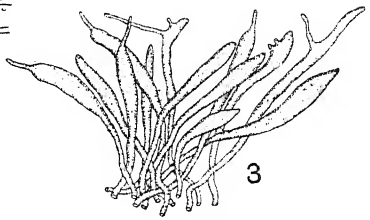

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# THE CONIDIA AND PARAPHYSES OF PEZICULA EUCRITA KARST.

*By Jessie S. Bayliss Elliott, D.Sc., and Helena C. Chance, M.Sc.*

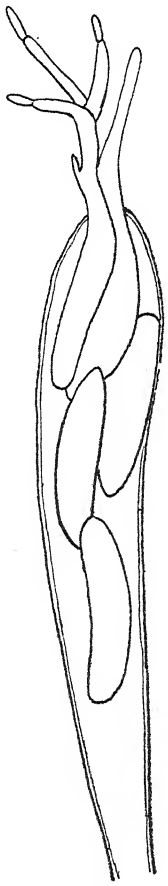
*Pezicula eucrita* Karst. was first recorded as British by Mr Carleton Rea (1), the specimen having been found by the late Dr J. W. Ellis, 1912. The fungus is recorded for Germany by Rehm (2), and for France by Boudier (3). Both of these mycologists consider it rare but it seems to be quite common in the woods of Warwickshire (Sutton Park and Tanworth-in-Arden).

In some descriptions of the fungus, the colour is given as ferruginous yellow, but our specimens, although at first ferruginous yellow, gradually became paler in colour, even a dull white, due to the formation of conidia which are developed in great numbers, and cover the surface of the apothecia and so approximate more nearly to Karsten's description in Myc. Fenn. 1, 166: "apothecia pallide ochracea vel sordide ochraceo-pallescentia."

The formation of conidia by the fungus is not mentioned by any of the above mycologists, although the conidia apart from the apothecia are figured by Boudier (3). The conidia arise from the ascospores, either directly as buds from any part of the spore, or the ascospores may first produce germ-tubes, and from these numerous conidia may arise.

The ascospores very often germinate in the ascus, and conidia can be seen arising on the germ-tubes after they have penetrated the wall of the ascus.

The conidia are linear, quite unlike the ascospores, and are formed from any part of the spore or germ-tube in chains, bunches, or singly. The number of ascospores in the ascus is given by Boudier (3) as 8 and by Rehm (2) as 4–8. We have examined very many apothecia and have never found more than 6, usually 4 or 5.



× 800.
Spores germinating in ascus and budding of conidia.

The ascospores are very large and do not seem to be readily discharged from the ascus, although they have been under similar cultural conditions to *Peziza aurantia, Cudoniella acicularis* and *Dasyscypha virginea*, all of which we have frequently seen "puff" off their ascospores, yet we have never observed "puffing" in *Pezicula eucrita*.

We have also tried the effect of various chemical substances, solutions of silver nitrate, acetic acid, sulphuric acid, copper sulphate, alcohol, iodine, mercuric chloride, potassium nitrate, and sodium chloride (such as were used by Buller (4) in his experiments on *Peziza repanda*) on ripe asci lying in water, and found that none of them had the slightest effect in bringing about the discharge of ascospores, whereas ripe asci of *Dasyscypha Soppittii*, similarly treated, burst at once, discharging their ascospores. No doubt the profuse formation of conidia from ascospores which have germinated in the ascus, or from those lying on the surface of the apothecium may be correlated with the ineffective explosive mechanism of the asci.

When the ascospores of *Pezicula eucrita* were germinated in water in hanging-drop culture-chambers, the growth and profuse formation of conidia were similar to that seen under natural conditions; conidia treated similarly germinated and produced a small germ-tube, or they budded off conidia again.

Conidia were present in every apothecium examined, even in quite young specimens, but were more numerous in the more mature stages of growth.

In both young and old apothecia paraphyses were found. Some were long, slender and unbranched, whilst others were dichotomously branched and clavate, and similar to those figured by Boudier (3). Although the paraphyses are dichotomously branched they never presented the rigid dichotomy seen in those figured by Rehm (2), neither is there the abrupt transition from slender filament to clavate head.

The excipulum is parenchymatous and covered with short hairs. In all descriptions of this fungus no mention is made of the excipulum which is usually an important feature to note when identifying a discomycetous fungus.

## REFERENCES.

(1) Trans. Brit. Myc. Soc. 1912, Vol. IV, p. 198.
(2) Rehm in Rabenhorst's Kryptogamen Fl. I, 3, p. 255.
(3) E. Boudier.—Icones Mycologicae, Pl. 559, p. 330.
(4) A. H. R. Buller.—Researches on Fungi, p. 238.

# THE RED SQUIRREL OF NORTH AMERICA AS A MYCOPHAGIST.

*By Professor A. H. R. Buller, D.Sc., Ph.D., F.R.S.C.*

In the Transactions of the British Mycological Society for 1916, an interesting paper was published by Hastings and Mottram upon the edibility of fungi for rodents. It was shown by citations from other authors, by field observations, and by a series of experiments that both squirrels and rabbits attack the fruit-bodies of many of the higher fungi and devour them as food*. The investigations of Hastings and Mottram were made in England but their conclusion that squirrels and rabbits are mycophagists doubtless applies not merely to British species but very generally to non-British species the world over. As a contribution to our knowledge of the relations of rodent and fungi I shall here record a series of observations upon the Red Squirrel and its fungus food, made by myself and by several other naturalists in Canada and the United States.

The Red Squirrel or Chickaree has an extensive geographical range in North America, for it is found in the woods of Canada and the United States from the east coast to the Rocky Mountains. It does not hibernate profoundly during the winter for, on any sunny winter's day, it may be seen about the trees in woods. I myself have seen it in mid-winter at Winnipeg in a park and about houses. The Red Squirrel feeds on the seeds of fir-cones, nuts, etc., but it is also an habitual mycophagist. In the autumn, it often collects fleshy fungi in large numbers for its winter supply of food and it stores the fungi sometimes in holes and sometimes on the branches of trees. This latter mode of storage, although of peculiar interest, does not seem to be generally known to mycologists even in North America.

Whilst studying fungi in the woods at Gimli on the western shore of Lake Winnipeg, at Minaki on the Winnipeg River, and at Kenora on the Lake of the Woods, I have many times observed fruit-bodies of Hymenomycetes which had been partly devoured or otherwise injured by rodents. From the appearance of the damaged fungi which was similar to that described by Hastings and Mottram, I came to the conclusion that the destructive agent was sometimes a squirrel and sometimes a rabbit.

* S. Hastings and J. C. Mottram, The Edibility of Fungi for Rodents, Trans. Brit. Mycolog. Soc., Vol. v, 1916, pp. 364–378.

In the autumn of 1919, I spent many days studying the fungi in the woods about Kenora. There, in the first week of October, *Armillaria mellea*—the Honey Fungus—was exceedingly common, and I noticed that, here and there, clumps of it had been damaged by a rodent. I also found a few isolated, half-eaten fruit-bodies hanging in the forks of branches of trees at a height of from six to about twelve feet above the ground. Two of these fruit-bodies I identified as *Armillaria mellea* and one as *Hygrophorus chrysodon*. I suspected that the destructive agent had been a Red Squirrel, for Red Squirrels were not uncommon in the woods. On October 6, my suspicions were confirmed. On that day I was approaching the Lake of the Woods and, just as I came to its margin, I saw a Red Squirrel on the top of a wood-pile close by the water's edge not twenty feet away. I stood still and observed that the squirrel was sitting on its hind legs with its tail curled over its back and was engaged in eating an agaric held in its fore-paws. I watched this little scene for some moments and then drew nearer, whereupon the squirrel suddenly dropped the fungus and darted away. I then went up to the wood-pile and recovered the fungus which proved to be a fruit-body of *Armillaria mellea*. The pileus had been eaten all around the periphery; but the disc showed the characteristic honey colour and scales, and the stipe still retained its annulus and its peculiar dingy yellow base. On the ground at the foot of the wood-pile I found a clump of *Armillaria mellea* fruit-bodies, some of which had been broken off by a rodent. Doubtless, this clump had been the source of the fruit-body which the squirrel had been eating.

Dr W. P. Fraser, Plant Pathologist of the Dominion Division of Botany, made the following statements to me: "In some of the woods in Pictou County, Nova Scotia, Red Squirrels are very numerous. Many scores of times I have seen these animals carrying or eating the sporophores of Hymenomycetes. A squirrel, after seizing a sporophore upon the ground and before eating it, usually carried it to the top of a stump or log or up to one of the branches of a tree. Partially devoured sporophores were often left lying about on stumps, logs, etc. Most of the fungi were Russulae."

Dr E. M. Gilbert of the Botanical Department of the University of Wisconsin told me that in the woods of Wisconsin he had often watched squirrels picking fungi, running with them along the ground, carrying them up trees, and eating them on the branches. When making these observations, he usually lay on the ground with his head resting on a cushion. Among the fungi carried up into the trees were various species of Russula and also *Lactarius piperatus* parasitised by *Hypomyces lactifluorum*.

It thus appears that the Red Squirrel is just as keen a mycophagist in the State of Wisconsin as in Nova Scotia more than a thousand miles distant.

Professor J. E. Howitt of the Ontario Agricultural College told me that at Muskoka, Ontario, in the month of September, he had often seen squirrels carrying fungi about trees, and that once he had seen an Amanita so carried. Sometimes the squirrels fetched and carried fungi with great persistency for several days in succession. Doubtless they were laying up provender for the winter.

The Red Squirrel stores up fruit-bodies of fungi for the winter often in large quantities. Sometimes the fruit-bodies are: (1) stored in bulk in a hole in a tree, in an old crow's nest or in some disused building, etc., but sometimes they are (2) hung up separately in the horizontal forks of trees. When thus hung up in the autumn, they soon dry and thus become preserved until the snow is on the ground and they are required for food.

(1) *Storage in bulk.* Mr Stuart Criddle of Treesbank, Manitoba, in a letter to the author, says: "I have often found fungi stored by squirrels above ground but never under ground. The chief places where I have found fungus stores have been woodpeckers' holes, hollow trees, and birds' nests—especially crows' nests." Soon after writing thus, Mr Criddle very kindly sent me a collection of dried fungi which had been stored by a squirrel in an old box in the loft of a disused house. In the collection there were 116 fruit-bodies altogether, many still quite intact, but some partially devoured and some represented only by large fragments. Of these 116 fruit-bodies, 22 were Boleti and 94 Agaricaceae. The former weighed $6\frac{1}{4}$ oz. and the latter 14 oz., so that the total weight was 1 lb. $4\frac{1}{4}$ oz. The fruit-bodies were sent to me in February and, owing to this being a very dry time of the year, they were exceedingly dry and very tough or brittle. When being gathered by the squirrel, they must have weighed many pounds. Some of the pilei bore the characteristic marks of a squirrel's incisor teeth. Many of the Boleti, and perhaps all, belonged to *Boletus scaber* and, among the Agaricaceae, there were at least two species of Russula, at least one species of Cortinarius, a Hypholoma—possibly *H. fasciculare*, and *Lactarius piperatus*. Some of the fruit-bodies of the last-named species had been parasitised by *Hypomyces lactifluorum* and therefore showed only slight ridges beneath their pilei in place of gills. A second collection of fungi sent me by Mr Stuart Criddle from another squirrel's home at Treesbank was even larger than the first for it contained between two and three hundred fruit-bodies. These, except in their

larger number, resembled the fruit-bodies of the first collection, so that a further description of them is unnecessary.

Mr Norman Criddle of the Dominion Department of Agriculture, has informed me by letter that he has never yet found fungi mixed with the usual winter stores of squirrels but that, nevertheless, he has found "old holes in trees literally crowded with semi-dry fungi which had apparently been stored as they were gathered and not previously dried." He further states that the fungus stores were invariably abandoned so that he could never trace the owner. These stores resembled those already described and may well have been collected by the Red Squirrel.

Dr C. N. Bell of Winnipeg has a summer-house at Minaki, a village situated where the Canadian National Railway crosses the Winnipeg River, 114 miles east of Winnipeg. This house, after having been closed for the winter in the autumn of 1916, was invaded by squirrels. The squirrels stored cones and fungi in the attic and made two nests in the mattresses on the beds. The number of stored-up fungi was large. Dr Bell wrote to me concerning the invasion of his house as follows:

"On opening my summer-house on the shore of Sandy Lake in the village of Minaki in the spring of 1917, I found unmistakable evidence that one or more of the Common Red Squirrels which play about the rocks and trees of the locality, had obtained access to the house, for there were two squirrels' nests in the mattresses on the beds and, in the attic, many gnawed pine-cones and a large quantity, say two or three quarts, of dried fungi. Also, many dried stalks of fungi were scattered about the other parts of the house accessible from the attic. Some individual squirrels have become so tame that they run up the steps to the veranda floor and, holding on to the wire screening, peer in on us while we sit at meals; and, occasionally, they have eaten crumbs out of my little daughter's hand. At times they are rather a nuisance as they frequently jump from the trees to the roof of the house and scamper about in the very early morning, at the same time making their chattering noise. Closing up every crevice in the roof and attic has effectually prevented them from entering the house since 1917."

The above observations made by Messrs Stuart Criddle and C. N. Bell prove conclusively that the Red Squirrel does store fleshy fungi in bulk in the autumn for winter use. The air in Manitoba during the autumn and winter is very much dryer than in England, so that the collected agarics dry without rotting or becoming unduly mouldy.

(2) *Storage in the forked branches of trees.* When I first heard of squirrels storing fungi in the branches of trees, the story

sounded in my ears like a romance and I was somewhat sceptical. However, as a result of a series of enquiries, although I myself have not as yet seen a tree with more than two fungi hanging in it, I cannot now doubt that trees laden with fungi by squirrels have been observed by others. Thompson Seton writes of them quite familiarly and his observations are supported by others made by M. W. Gorman in Alaska and by my personal friends and acquaintances at Winnipeg.

Thompson Seton in his well-known book on the mammals of North America writes of the Red Squirrel as follows:

"The second food supply in winter is mushrooms, chiefly of the genus Russula. If these were to be stored in the same way as the other provisions they would doubtless rot before they could be of service. The Squirrel stores them in the only available way, that is, in the forked branches of the trees. Here they are safe from the snow that would bury them, from the Deer and Field-mouse that would steal them, and instead of rotting, they dry up and remain in good order until needed.

"I have seen Red Squirrels storing up these mushrooms in the Sandhills south of Chaska Lake, Manitoba, in the Selkirk Mountains, on the Ottawa, and on the upper Yellowstone River. The Squirrel's sense of private ownership in a mushroom-stored tree is not so clear as its feeling regarding a hoard of nuts it has gathered.

"During early winter in Manitoba I have once or twice seen a Red-squirrel dig down through the snow to some mushroom still standing where it grew, and there make a meal of it.

"While camped at Caughnawanna, on September 14th, 1905, I was witness of a comic display of frugality and temper on the part of a Red-squirrel. A heavy footfall on the leaves had held me still to listen. Then appeared a Chickaree labouring hard to drag an enormous mushroom. Presently it caught in a branch, and the savage jerk he gave to free it resulted in the 'handle' coming off. The Squirrel chattered and scolded, then seized the disc, but again had the misfortune to break it, and now exploded in wrathful sputterings. Eventually, however, he went off with the largest piece and came back for the fragments one by one.

"The scene was an exact reproduction of one described by Dr Merriam in 1884."

Thompson Seton evidently thinks that the tree-fork mode of storage is the only kind of storage for fungi resorted to by the Red Squirrel, but in this he is in error for, as I have shown by citing the observations of Stuart Criddle and C. N. Bell, the Red Squirrel often stores up fungi in bulk in various holes and cavities. I suspect, but am not sure, that bulk-storage in holes

and cavities is more common than storage in the branches of trees.

M. W. Gorman who has botanised in Alaska, is reported by W. A. Murrill as having made the following statement*:

"In the region west of the Yukon River the small red or 'pine' squirrel lives during the winter upon the seeds of *Picea alba* and mushrooms. The latter are collected in large quantities during the summer and placed in the forks of branches and other secure spots above the ground to dry." Three different kinds of brownish-coloured agarics were noticed by Gorman who says that the squirrels visit their collections every day, even in the coldest weather.

The two following statements sent to me in writing by Mr Ernest Hiebert and Mrs Doern, both of whom are known to me as careful observers, supplement one another and prove in the clearest manner that, in Manitoba, the Red Squirrel not only stores fungi in particular trees in the autumn but also feeds upon the fungi so stored during the winter.

Mr Ernest Hiebert thus recounts his observations:

"In the middle of August, 1917, at Sandy Hook, near Gimli, Manitoba, I noticed what appeared to be a mushroom stuck between the lower branches of a spruce tree. Upon closer examination I discovered several more fungi in the same tree to the number of twelve in all. Most of them were in the lower branches about fifteen feet from the ground and a few as high as forty feet from the ground. They had all been placed between the horizontal forks of the twigs in the upright position in which they grow. I removed several of these fungi and found them quite dry and all apparently belonging to the genus Russula except one, which I took to be *Lactarius piperatus*.

"Several days later in the same grove of spruce trees, I came across a Common Red Squirrel carrying a fungus along the ground. Upon being pursued, it dropped the fungus which proved to be a perfectly fresh Russula."

Mrs A. H. Doern's observations were made in a suburb of Winnipeg and are still more interesting. She says:

"In October, 1918, I noticed a common red squirrel carrying a mushroom up one of the trees which grew in my yard at Norwood. The fungus was then placed between the twigs so that the gills looked downwards. Several more mushrooms were placed in a similar position in the same tree; and, during the winter that followed, I repeatedly watched the squirrel eat of these dried mushrooms. The squirrel would remove a mushroom from the twigs on which it had rested, nibble at it, and then replace it as before but in some other part of the tree.

* W. A. Murrill, Animal Mycophagists, Torreya, Vol. II, 1902, pp. 25–26.

Finally, during a cold spell in mid-winter, the mushrooms which still remained all disappeared from the tree and, after this, the squirrel failed to return."

Another observer who has watched squirrels taking fungi up into trees and storing them there is my friend and colleague, Dr Gordon Bell, who writes as follows:

"I have often seen squirrels carrying pieces of fungi up into trees. At Fox Lake in Ontario there was a large pinkish fungus which was very common in the woods and which interested me because I wished to find out whether or not it was edible. One day in the latter part of August, for fully fifteen minutes, I watched a red squirrel carry pieces of the fungus up into a pitch-pine tree and deposit them in the forks made by the branches. I have also seen squirrels in Fort Rouge, Winnipeg, carrying pieces of a Peziza-like fungus up into trees. I think it highly probable that the squirrels eat these fungi after they have dried, but I cannot assert this from actual observation."

From the foregoing evidence, it appears that the storing of fungi in the branches of trees in the autumn by the Red Squirrel is a well developed instinct. It is remarkable with what care the fungi are deposited. The fork of a branch is first selected and then the stipe is pushed downwards through it so that the pileus rests on the twigs, the result being that the fruit-body as a whole cannot fall to the ground by its own weight or be easily dislodged by the wind or by the swaying of the branches. The trees chosen by the squirrels for their open larders are usually Spruce-trees.

In England, during the late autumn and winter, as is well known, the climate is mild, the rainfall heavy, and the periods of frost not very intense or long continued. The English squirrel lays up for the winter a store of nuts and seeds but, so far as is known, never any fungi. Fleshy fungi, if stored by this animal either in holes or on the branches of trees would, owing to the dampness and mildness of the English climate, surely be apt to go rotten rather rapidly. On the other hand, in the inland parts of Canada and of the northern United States, the climate, during the late autumn and winter, is relatively very cold, the precipitation relatively slight and in the form of snow, and the frost very severe and prolonged. In central and western Canada and in North Dakota, snow lies upon the ground and the earth is frost-bound for at least four months each year. In the northern part of North America, therefore, the storage of winter food-supplies by squirrels is even more important than in England. The Red Squirrel lays up for the winter not merely cones and nuts but, in addition, a store of fungi. Owing to the dryness and coldness of the climate, the fungi hung in the branches of

trees by squirrels in late autumn, dry without rotting and remain good to eat until the spring comes, while those deposited in bulk in holes, although moist when collected, become partially dried and, in this condition, preserved by the action of the frost. The fungi heaped together in holes, etc., are put by the weather into a state of cold storage resembling that in which mankind now preserves many of his food-stuffs, such as beef and mutton. The storage of fungi for the winter, by increasing and varying the supply of food, is undoubtedly beneficial to the Red Squirrel and is due to an instinct which appears to have been developed in response to severe winter conditions.

Mr J. B. Wallis, Principal of the Machray School, Winnipeg, once observed a squirrel which, instead of storing fungi in the branches of a tree, hung up there two chickens. As is well known, the Red Squirrel robs birds' nests and kills birds freely. The killing of the two chickens, therefore, was not very extraordinary; but the hanging of the chickens in the forked branches of a tree was a very curious and unusual proceeding and suggests that for once the fungus-storing instinct had become perverted. Mr Wallis has written to me concerning the incident as follows:

"A red squirrel had taken up its abode just behind a farmhouse near Thornhill, a village some eighty miles W.S.W. of Winnipeg. This squirrel had become quite friendly and showed no fear of its human neighbours. One day, whilst visiting the house, I was called outside and here was the squirrel laboriously dragging by the neck, up a small oak-tree, a chicken nearly as big as itself. On looking more closely, two other chickens were discovered, hung by their heads in forked branches. The three chickens had all been killed by bites at the back of the head. The squirrel, on perceiving my friend and myself, immediately seemed to sense disapproval of his thrifty habits and retired rapidly to a high bough from whence he was dislodged with a charge of number six shot. As a really advanced squirrel, he thus fell a victim to his very advancement."

*Summary.* The Red Squirrel of North America not only feeds on the seeds of fir-cones, hazel-nuts, etc., but is also an habitual mycophagist. In the late autumn, it often collects fleshy fungi in large numbers for its winter supply of food, and it stores these fungi sometimes *en masse* in holes in tree trunks, old birds' nests, etc., and sometimes separately on the branches of certain trees.

# THREE NEW BRITISH COPRINI.

*By Professor A. H. R. Buller, D.Sc., Ph.D., F.R.S.C.*

1. *Coprinus echinosporus* Buller, sp. n.

Pileus 15–18 mm. high before expansion, white, then grey, and finally dirty yellowish-brown, oval, then conico-campanulate, becoming flattened, about 3 cm. broad, and finally revolute and radially splitting along the lines of the longest gills, at first clothed with short dense down which then breaks up into small, delicate, thin, fugacious tufts or scales consisting of slender branched cells, 80–150 × 5–10$\mu$. Stipe 9 cm. × 3 mm. at base, white, slightly attenuated upwards, straight or flexuose, firm, adpressedly hairy. Gills blackish at maturity, adnexed, very thin, very slightly wedge-shaped, autodigesting on the edges. Flesh brownish-yellow, brownish at the apex of the pileus, becoming finally dirty ochraceous. Spores black in the mass, very dark and opaque under the microscope, finely warted or echinulate, oval, more or less pip-shaped, truncate at the apex, 9–11 × 5–7$\mu$, with an apical germ-pore through which a transparent membrane often protrudes; basidia of three lengths, surrounded by 3–4 paraphyses. Cystidia abundant, rounded at both ends, generally parallel-sided, rarely globose, 70–95 × 23–30$\mu$, varying up to 105$\mu$ in length and 45–57$\mu$ in diameter. Habitat, on sticks dredged from a pool at Kew, October, 1911.

The most striking character of this species lies in the coarsely verrucose spores which are truncate at the apex; but, in general aspect, it resembles *Coprinus lagopus* Fr. (= *C. fimetarius* and *C. cinereus* of authors).

Pileo 15–18 mm. alto, ovali, albo-cinerascente, dein 3 cm. lato, conico-campanulato, sordide fusco-lutescente, postea revoluto radiatimque fisso, farina tenui consperso. Stipite albo, sursum attenuato, firmo, adpresse pubescente. Lamellis adnexis, atris; sporis amygdaliformibus, verruculosis vel echinulatis, apice truncatis, 9–11 × 5–7$\mu$; cystidiis copiosis, ellipticis.

2. *Coprinus bisporus* Lange.

Lange, Studies in the Agarics of Denmark, pt. II, Coprinus, Dansk Bot. Ark., bind 2, no. 3, p. 50. Synonym: *Coprinus bisporiger* Buller in Trans. Brit. Myc. Soc., 1911, p. 350.

Pileus 5–12 mm. high and broad, pallid or ochraceous, then greyish-hyaline, ovate-conical, then revolute and radially sulcate up to the disc which remains prominent, covered with erect, minute hairs, 45–120 × 12–24$\mu$. Stipe 3–8 cm. × 1–3 mm., white, equal, strigose at the base. Gills white, then blackish, adnexed, narrow, 2 mm. wide. Flesh white, ochraceous under the pellicle of the pileus, thin except at the disc. Spores purplish-brown in the mass, dark brown under the microscope, oval or oblong elliptical, 12–14 × 6–7$\mu$; basidia broadly ovate, 8–10 $\mu$ in diameter, with 2 sterigmata and 2 spores. Cystidia inflated, ovate, 80–90 × 45–55$\mu$. Habitat, wood and dung, at Kew, Aug.–Oct., 1911 and 1916.

The British specimens found at Kew, on which this description is based, had invariably two spores only on each basidium and never three or four. By this character, combined with the deeply sulcate pileus with its prominent disc, the strigose base of the stem, and the ovate cystidia, this species can be readily distinguished.

### 3. *Coprinus curtus* Kalchbr.

Lange, Studies in the Agarics of Denmark, pt. II, Coprinus, Dansk Bot. Ark., bind 2, no. 3, p. 45, t. 1, fig. h. Synonym: *Coprinus plicatiloides* Buller, in Researches on Fungi, Vol. 1, 1909, p. 69.

Pileus 3–8 mm. high when young, 0·5–1·5 cm. broad when expanded and flattened, foxy-red or rufescent to tan colour at first, becoming grey to dark grey, at first oval to cylindrical or elliptical, then expanded and flattened with a strongly depressed disc, splitting along the lines of the gills and becoming plicate, bearing a certain number of minute, scattered, flaky, separable, rufescent or whitish scales composed of globose, angular, or elliptical cells, often in chains, 12–30$\mu$ in diameter, some brown and some colourless, not ornamented with crystals of calcium oxalate, the pileus also villose or downy with many colourless hairs, 70–100 × 5$\mu$, enlarged at the apex where minute drops of a clear fluid are exuded under moist conditions. Stipe 2–8 cm. × 1–2 mm., white, becoming stained with dull yellow, equal, smooth, hollow. Gills grey, then black, at first attached to the stem by the margin for its entire length, then adnexed and finally free, linear, narrow; margin before autodigestion begins slightly divided and fimbriate. Flesh white, thin. Spores black in the mass, dark brownish to black under the microscope, elliptical, 9–15 × 6–9$\mu$. Cystidia on the sides of the gills none. Habitat, on horse dung at Kew and Taunton, August and September, 1911, commonly coming up on horse dung in cultures in glass dishes.

The distinguishing characters of this species lie in the foxy-red colour of the very young pileus, the minute reddish or whitish scales which remain on the expanded pileus interspersed with clavate hairs, the finally depressed disc, the deep black spores and the absence of cystidia on the sides of the gills. The pileus, when expanded, reminds one of that of *Coprinus plicatilis*. Sometimes very minute or dwarf fruit-bodies are to be found along with similar dwarfs of *C. lagopus* in crevices in old horse dung masses. The fungus is common on horse dung cultures at Winnipeg.

## NEW OR RARE MICROFUNGI.

*By A. Lorrain Smith, F.L.S., and J. Ramsbottom, M.A., F.L.S.*

### PHYCOMYCETES.

*Phytophthora cryptogea* Pethybr. & Laff. in Sci. Proc. R. Dublin Soc. XV, p. 498, 3 pls. 1918.

On roots and stems of *Lycopersicum esculentum* and Petunia sp. Ireland.

### PYRENOMYCETES.

*Nectria fusco-purpurea* Wakef. in Kew Bull. 1918, p. 232.

On dead branches of plum (Pond's Seedling). Wisbech (J. C. F. Fryer, 1917; A. D. Cotton, 1917).

*Melanospora Zobelii* Fuck.

On the hymenium of *Sepultaria arenicola* Mass. Coll. W. G. Travis. Sand-hills, S. Lancs. Recorded in Trans. Brit. Mycol. Soc. IV, p. 314, 1914.

*Sphaerulina intermixta* f. *valde-evoluta* Grove in Journ. Bot. LVII, p. 210 (1 fig.), 1919.

Differing from the species in the somewhat scattered perithecia, slightly larger spores and in the presence of an occasional thin longitudinal septum.

On dead branches of *Rosa damascena*, associated with *Hendersonia Rosae* in the Botanic Garden, Edgbaston, Birmingham, May, 1919.

### HYSTERIACEAE.

LOPHODERMIUM LINEATUM n. sp.

Peritheciis nigris, nitidis, in series lineares dispositis, arcte ellipsoideis utrinque subacutis, circa ·25–1 mm. long., ·1–·15 mm. lat.; paraphysibus filiformibus; ascis crasse cylindraceis breve stipitatis, 75–105$\mu$ long., 18–20$\mu$ lat.; sporis cylindraceis, ob-

tusulis, hyalinis 28–35$\mu$ × 2½–3$\mu$, strato mucoso usque ad 3$\mu$ lat. obvolutis.

In foliis dejectis *Pini excelsae.*

Collected by Dr G. Pethybridge at Wexford, Ireland, Oct. 1919. The specimen agrees in several respects with *L. brachysporum* Rostr. but the spores of the latter are of different dimensions, being shorter and wider.

**DISCOMYCETES.**

*Sepultaria sepulta* (Fr.) Mass.

Collected by W. G. Travis on sand-hills S. Lancashire in June, 1920. In this specimen both the exterior and the disc of the ascocarp are a dull black. In section the paraphyses are a light shade of dull brown towards the clavate tips, but collectively they form a thick brown epithecium, much darker than might be inferred from the usual descriptions. Paraphyses in *Sepultaria* are generally described as "hyaline."

*Keithia thujina* Durand. Mycologia, v, 1913, p. 9, pl. 81, figs. 1–5, 1913; Pethybridge in Quart. Journ. Forestry, April, 1919.

Ascomata epiphyllous, erumpent, orbicular or ellipsoid, pulvinate, olivaceous or brown-olivaceous, 1–1·28 mm. long, ·5 mm. wide, the epidermis not laciniate; asci clavate 80–100$\mu$ × 18–20$\mu$; spores 2 in the ascus, brown-olivaceous, unequally septate at the anterior end, punctate 22–25$\mu$ × 15–16$\mu$; paraphyses furcate, septate, clavate at the tips, olivaceous.

On *Thuja.* Found by Dr Pethybridge on young trees of *Thuja* at the Forestry Station, Baunreagh, Queen's County, and at Lough Esk, Donegal.

**SPHAEROPSIDEAE.**

*Phyllosticta Bolleana* Sacc. Syll. Fung. III, p. 15 (1884), *P. Euonymi* Thüm. non Sacc.

Spots irregular, whitish grey with dark margin; pycnidia scattered, globose, up to about 230$\mu$ in diam.; epiphyllous, semi-immersed, black; spores small, ellipsoid, rounded at the ends, 4–5$\mu$ × 2–2·5$\mu$, greyish-white, brownish in mass.

On living leaves of *Euonymus japonicus.* Richmond, Surrey, June, 1916.

The same fungus was found at Wisley, Surrey, June, 1916, on dead leaves of *E. japonicus* the stem of which was attacked by *Cytospora Euonymi,* Cooke.

*Sphaeronema piliferum* (Fr.) Sacc. in Mich. II, p. 342, 1881, *Sphaeria pilifera* Fr.

Pycnidia superficial, crowded, black, spherical, c. 250$\mu$ in diameter, prolonged into a long, black, hair-like, smooth, often

flexuose beak 1050–1200 × 25–30$\mu$; spores ovoid, cylindrical or allantoid, continuous, 3·5–5 × 2·5$\mu$; long, dark brown, septate hairs, 2–3$\mu$ in diameter, are given off from the base of the pycnidia.

On pine wood, Camberley, Surrey, Aug. 1916.

The fungus appeared in great quantity on sawn tree stumps, on pine wood and on boxes made from it and not properly dried. The hyphae did not penetrate the wood but the discoloured appearance of the boxes made them unsaleable.

The description of the fungus given above agrees closely with that by A. Jaczewski in his Monograph of the genus *Sphaeronema* (Nov. Mém. Soc. Imp. Nat. Moscow, XV, p. 330, 1898). Saccardo, Allescher and Diedicke give the spore measurements as included within the limits 3–4 × 1–1·5$\mu$, and the two latter record a smaller size for the pycnidium. In the Camberley specimens spores of this smaller size were obtained several times when the pycnidia were crushed. They always emerged with a mass of food reserve material: the mature spores escaped through the ostiole.

*Ceuthospora Mahoniae* Grove in Journ. Bot. LVI, p. 314, 1918.

On dead leaves of *Mahonia japonica*, Studley, June.

*C. latitans* (Fr.) Grove, loc. cit.

On dry, dead, blackening leaves and twigs of *Vaccinium Vitis-idaea*. Cheviots, Shropshire, Ayrshire, etc.

*Diplodia Opuli* Pass. in Atti. R. Accad. Lincei Rom. ser. 4, VI, p. 465, 1889–90; Grove, tom. cit. p. 317.

On dead twigs of *Viburnum*. Hunts Cross, Cheshire (Ellis), April.

*Ascochyta Boydii* Grove, tom. cit. p. 315.

On living leaves of *Alisma Plantago*. Stevenston, Ayrshire (D. A. Boyd); Cheshire (Ellis), July–Sept.

*A. Equiseti* Grove, loc. cit.

On dry dead stems of *Equisetum limosum*. Ardrossan (Boyd); Harborne and King's Norton.

*A. Mercurialis* (Desm.) Grove, tom. cit. p. 316.

On living leaves of *Mercurialis perennis*. Arran and Ayrshire (Boyd), July–Aug.

*A. Tiliae* Kab. & Bub. in Hedwigia, XLVI, p. 293, 1907; Grove, loc. cit.

On living and fading leaves of *Tilia grandifolia*. West Kilbride, Ayrshire (Boyd), July.

*A. Viburni* Sacc. Syl. III, p. 387, 1884; Grove, loc. cit.

On living leaves of *Viburnum Opulus*. Beitte, Ayrshire (Boyd), August.

*A. Phaseolorum* Sacc. in Mich. I, p. 164, 1878.

Spots indefinite, ochre-brown on drying; pycnidia epiphyllous, orbicular-lenticular, 100$\mu$ in diam., with an apical pore; spores oblong, uniseptate, constricted, 10 × 3$\mu$, biguttulate, hyaline.

On leaves of *Phaseolus vulgaris*.

On pods of Phaseolus. Richmond, August, 1916.

*Actinonema Aquilegiae* (Roum. & Pat.) Grove, tom. cit. p. 343.

On living or fading leaves of *Aquilegia vulgaris*. Saltcoats, Ayrshire (Boyd), Kew Gardens, Hereford, July–Aug.

*Diplodina Cirsii* Grove, tom. cit. p. 317.

On white spots on the stalk of *Cirsium arvense*. King's Norton, June.

*Hendersonia Typhae* Oud. in Arch. Néerl. Sci. exact. et nat. II, p. 19, 1867.

Var. *major* Grove, loc. cit.

On dead leaves of *Typha latifolia*. Killermount, Dumbartonshire (Boyd), Oct.

*H. vagans* Fuck. Symb. Myc. p. 392, 1869.

Form *cuspidati* Grove, tom. cit. p. 318.

On dead stems of *Polygonum cuspidatum*. Edgbaston, Birmingham, May.

*Stagonospora Tussilaginis* (Fuck.) Died. in Ann. Mycol. X, p. 482, 1912. *Septoria Tussilaginis* Fuck., *Septoria Fuckelii* Sacc.

Spots on the upper surface of the leaf, rusty brown, round, indefinite, with a blood-red border; pycnidia about 500$\mu$ in diam., with thin, rusty brown, parenchymatous wall thickened and almost black round the pore (25$\mu$ wide), finally emergent with prominent ostiole; spores elongate clavate, somewhat bent, with blunt ends, 4–5-septate, green, coherring for some time in a mucilaginous ball.

On leaves of *Tussilago Farfara*. Mortlake, Surrey, Oct. 1916.

*S. Hygrophila* Sacc. in Malpigh. XIII, p. 22, fig. iii 2, 1899. Var. *vermiformis* Grove in Journ. Bot. LVI, p. 318, 1918.

On living leaves of *Oxalis Acetosella*. Dalry, Ayrshire (Boyd), Aug.

### LEPTOSTROMATACEAE.

*Leptothyrium Hederae* Starb. in Bih. K. Sw. Vet. Akad. Handl. Stockholm, XIX, Afd. iii. n. 2, p. 96, 1894; Grove in Journ. Bot. LVI, p. 319, 1918.

On dead leaves and petioles of *Hedera Helix*. West Kilbride, Ayrshire (Boyd), Dec.

*Melasmia Urticae* Grove, loc. cit.

On dead stems of *Urtica dioica*. Stevenston, Ayrshire (Boyd), Feb., March, associated with *Rhytisma Urticae*.

### EXCIPULACEAE.

*Heteropatella umbilicata* Grove, tom. cit. p. 319, 1918.

On dead stems of herbaceous plants. Not common.

*Sporonema strobilinum* Desm. var. *accedens*, Sacc. Syll. III, p. 679, 1884; Grove, tom. cit. p. 320, 1918.

On the apophysis of the cone scales of *Pinus sylvestris*. Tanworth-in-Arden (Dr Bayliss Elliott), June.

### MELANCONIEAE.

*Gloeosporium Robergei* Desm. in Ann. Sci. Nat. XX, p. 214, 1853; Grove in Journ. Bot. LVI, p. 320, 1918.

On fading leaves of *Carpinus Betulus*, Stewarton, Ayrshire (Boyd), July.

*G. salsum* Grove, loc. cit.

On living leaves of *Cochlearia officinalis*, West Kilbride, Ayrshire (Boyd), Oct.

*Myxosporium carneum* (Lib. Exs. n. 882) Thum. in Hedwigia XIX, p. 181, 1880; var. *Carpini* Grove in Journ. Bot. LVI, p. 321, 1918.

On still living branches of *Carpinus Betulus* near Tanworth in Arden (Dr Bayliss Elliott), Feb.

*Colletotrichum Holci* (Syd.) Grove, tom. cit. p. 341.

On fading leaves of *Holcus mollis*. West Kilbride, Ayrshire (Boyd), Aug.

*C. petiolicola* (Brun.) Grove, loc. cit.

On fallen petioles of *Acer pseudoplatanus*. Eastham (Ellis), Nov.

*C. linicolum* Pethybr. and Laff. in Sci. Proc. R. Dublin Soc. XV, p. 368, 2 pls. 1918.

On stem leaves and seeds of *Linum usitatissimum*. Ireland.

*Cylindrosporium microspermum* Sacc. in Mich. II, p. 169, 1880–82; Grove, loc. cit.

On living leaves of *Saxifraga oppositifolia* which it kills. Crianlarich, Perthshire (J. R. Lee) July. Ben Lawers (Boyd).

*Cryptosporium Vincae* Otth. Bern. Mitth. p. 61, 1868. Var. *ramulorum* Grove in Journ. Bot. LVI, p. 342, 1918.

On dead stems of *Vinca major*. Seamill, Ayrshire (Boyd), 1918.

*Libertella Opuli* Oud. Contr. Fl. Myc. Pays Bas, XVII, p. 295, 1901; Grove, loc. cit.

On thin twigs of *Viburnum Opulus*. Storeton, Cheshire (Ellis), Feb.

**HYPHOMYCETES.**

*Sporotrichum chrysospermum* Harz. Hyphom. p. 19, pl. v. fig. 3, 1872.

Already recorded by Grove (Trans. Brit. Mycol. Soc. III, p. 368, 1911) on a stick. It covered a fairly large patch of decaying damp wood in the timber-yard, Chatsworth. Originally it was recorded as *Fomes* sp.

*Trichoderma Koningii* Oudem. in Arch. Néerl. Sci. exactes et nat. 1902, p. 291, pl. 31, figs. 1–7.

Tufts orbicular, woolly at first, white then vaguely green-punctate and spotted, at length aeruginous-green or brightly olivaceous; hyphae colourless, septate, branched, the branches alternate or opposite, the ultimate ramuli bearing conidia at the tips; conidia almost hyaline, ellipsoid 3–4$\mu$ × 2·5–3$\mu$, in green glomeruli 8–10$\mu$ diam., not mucilaginous.

Found by Oudeman in a gelatine culture of soil at Bussner, Holland, and stated by him to be very common.

On a rotten branch on the soil. Sherrett's Wood, Abbey Wood (St John Marriott), Dec. 1919.

*Botrytis truncata* Sacc. Syll. IV, p. 138, 1886. *Polyactis truncata* Cooke in the Journ. Quek. Microsc. Club. ser. 2, II, p. 142, pl. 10, fig. 5, 1885.

Tufts small, white. Conidiophores slender, flexuose, septate, with numerous short branchlets at the tip, the ultimate ramuli fastigiate or digitate, bearing at the tips an elongated oblong-ellipsoid colourless conidium abruptly truncate and often concave at the tips, the outer cell wall projecting like points, about 15–20$\mu$ × 7$\mu$.

First collected by Madame Bommer on the fronds of ferns in Belgium. Found by Mr St John Marriott on decaying wood, Co-operative Woods, Abbey Wood, Woolwich, Dec. 1919.

The conidia of Mr Marriott's specimen are generally shorter than 20$\mu$, but though the habitat is different there is no doubt that it is the same as the Belgian plant.

*B. Paeoniae* Oud. in Med. Konink. Ak. Wet. Amsterdam, p. 464, fig., 1897.

Mycelium within the leaf. Conidiophores long, numerous, emerging by the stomata, congregate in tufts, branched, the branches, three to five, produced spirally, once or more divided at the tips, the end cell developing to a globose or flattened swelling covered with fine spines; conidia (in heads 20–40$\mu$ across) ovate-elongate 16–18$\mu$ × 7–7·5$\mu$, hyaline or faintly coloured.

Causing disease of Paeonies. Spalding, Lincs. (J. K. Ramsbottom), April.

See Massee (Dis. Cult. Plants, etc. p. 267, 1910) on *Sclerotinia Paeoniae.*

MARTENSELLA Coemans in Bull. R. Ac. Belg. sér. 2, XV, p. 536, 1863.

Sterile hyphae creeping, branched; fertile erect, simple or dichotomous, septate; conidiophores lateral, short, curving at the apex. Conidia subfusiform biseriate along the upper surface of the conidiophore.

*M. pectinata* Coemans, loc. cit. t. 2, fig. 10.

Scattered or in tufts. Fertile hyphae greyish-yellow or greenish; conidiophores scattered, 7–9-septate; conidia biseriate-pectinate 18$\mu$ × 3$\mu$ on the curving boat-shaped branchlet.

Parasitic on hyphae of *Mucor* or *Saprolegnia.*

Found in a soil-culture by Miss Jewson at Rothamsted. Comm. W. B. Brierley.

*Ramularia Hypochaeridis* Magnus, in Verh. Bot. Ver. Prov. Brand. XXXVII, p. 83, 1895.

Leaf spots roundish, scattered, 2–5 mm. in diameter, brownish, almost constantly epiphyllous, with a violet coloured margin, sometimes concentrically zoned; tufts amphigenous; conidiophores emerging in tufts from the stomata, unbranched, rarely septate, somewhat bent, 27–38 × 2·5–3$\mu$; conidia cylindrical, blunt at the ends, often somewhat tapering, simple or uniseptate, 19–27 × 3–3·5$\mu$.

On living leaves of *Hypochaeris radicata.* Wisley, Surrey, June 1916.

The fungus was abundant at Wisley on the host plant on which were large decaying violet patches. The spores in our specimens measure up to 36$\mu$ long.

*R. acris* Lindr. in Acta Soc. Faun. Flor. Fenn. XXIII, no. 3, p. 14, 1902.

Leaf spots large, irregular, limited by the veins, yellowish or greyish-brown; tufts hypophyllous, whitish to reddish; conidiophores emerging from the stomata, straight, simple, mostly septate, blunt, 1–3-dentate at the tips, hyaline, 30–60 × 3$\mu$; conidia elongate-cylindrical, rounded at the ends, mostly 1-rarely 3-septate, straight, slightly constricted, hyaline, 22–34 × 3–8$\mu$.

On living leaves of *Ranunculus acer*. Oxshott and Sheen Common, Surrey, Oct. 1916; Addington, Oct. 1919.

*R. Tanaceti* Lind in Ann. Mycol. III, p. 431, 1905; Lindau in Rabenb. Krypt. Fl. I. viii. p. 514, 1906.

Spots covering entire pinnae or portions of the leaf, starting generally at the tips and spreading downwards, brown or dark brown, with a somewhat lighter margin; tufts scattered on the under surface; conidiophores emerging through the stomata, crowded; up to 38 × 4–4·5$\mu$; conidia cylindrical, blunt at the ends, occasionally in a chain of two, septate (1–3), 23–40 × 5$\mu$.

On living leaves of *Tanacetum vulgare*. Wisley, Surrey, June 1916.

The conidiophores in the Wisley specimens measure up to 60$\mu$ in length. The measurements in the description are those of Lind.

*R. brunnea* Peck, in 30th Ann. Report, New York State Museum, p. 55, 1878.

Spots brown, unequal, suborbicular, sometimes confluent; flocci occupying the larger spots and giving them an ashy tint, epiphyllous, fasciculate, short, delicate, spores cylindrical, colourless, very unequal in length, 12–40 × 3·5$\mu$.

On leaves of *Tussilago Farfara*. Headley, Surrey, Aug. 1916.

*R. Cirsii* Allesch. in Ber. d. Bayr. Bot. Ges. II, p. 18, 1892.

Spots on both sides of the leaf, circular, white with black border; tufts small, white; conidiophores 30–40 × 3$\mu$; conidia in chains, ovate-cylindrical, blunt at the ends, finally 1–3-septate, hyaline, guttulate 30–35 × 2·5–3·5$\mu$.

On living or decaying leaves of *Cirsium lanceolatum*.

Not uncommon on leaves of *C. arvense*. Oxshott, Surrey, Oct. 1916.

*R. Scrophulariae* Fautr. & Roum. in Rév. Mycol. XLIX, p. 81, 1891; Grove in Journ. Bot. LVI, p. 344, 1918.

On living leaves of *Scrophularia nodosa*. Ayrshire (Boyd), Trench Woods, Droitwich, July–Aug.

*Verticillium globuliforme* Bon. Abh. Geb. Mykol. p. 94, 1864; Grove in Journ. Bot. LVI, p. 345, 1918. Var. *ellipsoideum* Grove, loc. cit.

On culms of *Juncus*. Sutton Park, Warwickshire, May.

*Cercosporella Antirrhini* Wakef. in Kew Bull. 1918, p. 233.

On living leaves and stems of garden *Antirrhinums*. Worcester, Sept. 1917; also Birmingham, June 1918 (W. B. Grove).

*Mastigosporium album*, var. *muticum* Sacc. in Ann. Mycol. IX, p. 254, 1911; Kew Bull. 1918, p. 233.

On leaves of *Dactylis glomerata*. Kew, 1918, and Oxshott, Oct. 1917 (E. M. Wakefield).

*Torula fusca* (Bon.) Sacc. Syll. IV, p. 260, 1886.

Tufts spreading, pulverulent, brown. Conidia in chains, fusiform, brown, decumbent.

Growing on decaying *Bulgaria inquinans* and on rotten wood (*Corylus Avellana*).

A specimen, collected in Abbey Wood, has been referred to this somewhat imperfectly described species. It was growing over the disc of a *Peziza* (possibly *Ombrophila clavus*) as well as on the damp rotten wood. Superficially it is yellowish-brown, in mass under the microscope it is chestnut-brown. The sporophores are branched, the conidia from ovoid to fusiform in rather long chains, measure 7–14$\mu$ × 5$\mu$ C. H. Grinling and St John Marriott, Dec. 1919.

*Hadrotrichum anceps* Sacc. in Ann. Mycol. IX, p. 255, 1911.

Tufts usually hypophyllous, in lines, gregarious or somewhat scattered, shortly linear, minute, ·5 mm. long, brownish-black, prominent, firm; conidiophores densely packed, cylindrical, straight, rarely wider upwards, 35–40 × 5·5–6$\mu$, smoky brown, generally with one septum near the base; conidia globose, rarely ellipsoid-globose, 8–9$\mu$ diam., fuliginous, epispore thin, slightly punctate.

On fading leaves of *Brachypodium*.

Collected on fading leaves of *Arrhenatherum elatius* at Wisley, Surrey, June 1916.

The conidiophores of the British specimen reach a length of 65$\mu$ and the conidia are more persistently ellipsoid and measure up to 10–12$\mu$ × 8$\mu$; otherwise it corresponds exactly with Saccardo's species.

The *Arrhenatherum* was attacked by *Ustilago perennans*.

BOTRYOTRICHUM Sacc. et March. in Bull. Soc. Roy. Bot. Belg. XXIV, 1, p. 66, 1885.

Sterile hyphae growing in fascicles, simple, septate, grey.

Conidiophores short, developing at the base of the sterile hyphae, colourless, irregularly branched; conidia acrogenous, globose, simple, colourless.

*B. piluliferum* Sacc. et March. loc. cit. pl. 2, figs. 5–8.

Sterile hyphae crowded, slightly bent, smooth or slightly rough, 200–250$\mu$ × 3·5–5$\mu$. Conidia globose 11–14$\mu$ diam.

On rabbit dung.

On sacking, Baslow.

The specimen from Baslow grew as a grey felt on old and very dirty sacking. The fungus closely resembles the figures of the original specimens but the spores are larger, up to 20$\mu$ in diam., with a slightly roughened thick epispore.

*Cladosporium Typharum* Desm. Exs. N. 304.

Tufts in scattered lines, dark coloured or greyish spots. Conidiophores in groups upright or bent, sparingly septate, more closely septate towards the tips 75–175$\mu$ × 5–6$\mu$. Conidia elongate or ovoid, punctate, blackish-green, 2–4-celled, 16–22$\mu$ × 5–8$\mu$.

Found by C. Rea on *Typha latifolia*, New Pool, Malvern, Worcestershire, Aug. 1919.

This species somewhat resembles *Heterosporium Typharum* Cooke, but the spores are smaller than in that species.

*Helminthosporium Warpuriae* Wakef. in Kew Bull. 1918, p. 233.

On an injured stem of *Warpuria clandestina*. Tropical Pits, Kew, July, 1917. (Stapf.)

*Cercospora dubia* Wint. in Hedwigia, XXII, p. 10, 1883; Grove in Journ. Bot. LVI, p. 345, 1918.

On leaves of *Atriplex patula*. Near the Severn, Worcester, Sept.

*Microcera coccophila* Desm. in Ann. Sci. Nat. 3 ser. X, 359 (1848).

A specimen of this fungus was collected by Mr Grinling at Woolwich. The habit is that of *Microcera* but the spores are blunt at the ends, and some of them are larger than the sizes published, being about 120–145$\mu$ × 7–9$\mu$. It is probably a form of the above.

Communicated by Miss E. M. Wakefield.

## USTILAGINEAE.

*Ustilago perennans* Rostr., Overs. K. Dansk. Vid Selsk. Forh. 1890, p. 15.

Spore masses in the ears of the grass dark-brown. Spores globose (rarely ovoid), 5–9$\mu$ diam., the surface clear brown and finely punctate. Mycelium perennial in the root-stock.

In flowers of *Arrhenatherum elatius*. Symonds Yat, May, 1914. Leg. H. H. Whetzel. Herts, June, 1919. Leg. C. H. Grinling.

# GALACTINIA AMETHYSTINA (PHILL.) WAKEF.

*By E. M. Wakefield, F.L.S.*

Under the name *Humaria Phillipsii* Cooke described a fungus which he said he found mixed with the type specimens of *Ascobolus amethystinus*, Phill. It is characterised by its deep purple colour, and large, fusiform, coarsely warted spores, and has been found on several occasions since Cooke's time. In a note in the *Naturalist*, 1906, pp. 9–10, Massee and Crossland state that they observed spores which were shot off naturally to be hyaline, and conclude therefore that the purple-coloured spores seen in microscopic preparations are merely stained from the tearing of the surrounding tissues. It is known, however, that under suitable conditions spores which are not fully mature may be set free naturally. In the specimens gathered at Baslow young hyaline spores and fully mature purple spores were seen together in the same preparation, and there seems little doubt that the spores do at length become coloured.

On looking up the original specimens and descriptions, it is obvious that Phillips' description of *Ascobolus amethystinus* was drawn up from this plant, called *Humaria Phillipsii* by Cooke, and later transferred to *Galactinia* by Boudier. On the other hand, as Cooke noticed, the type material contained also a true Ascobolus. This is a small species, with cups 2–3 mm. across in the dried state. The asci are clavate, about 15 $\mu$ long, and the spores sub-distichous, occupying only the upper, broader part of the ascus. The spores are smooth, elliptical, deep-clear brown, 20–24 × 12–14 $\mu$, rather thick-walled. Filiform paraphyses are present.

For this Ascobolus another name will have to be found. It will probably prove to be an already described species. "*Ascobolus amethystinus*" of Phillips' description is absolutely synonymous with *Galactinia Phillipsii* (Cke.) Boud. The specific name will therefore have to be changed, and this plant with purple warted spores must be called *Galactinia amethystina* (Phill.) Wakef.

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Rea, Mr Carleton, B.C.L., M.A., 6, Barbourne Terrace, Worcester (1918).

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3. Alcock, Mrs N. L., Ministry of Agriculture, Pathological Laboratory, Kew (1919).
4. Allen, Mr W. B., Benthall, Broseley, Salop (1902).
5. Arnold, Mr F., M.A., Holmdene, 56, Cathedral Road, Cardiff (1917).
6. Barr, Rev. Robert, The Manse, Nielsden, Renfrewshire (1918).
7. Barrington, Dr F. J. F., University College Hospital, Medical School, University Street, London, W.C. 1 (1901).
8. Bartlett, Mr A. W., M.A., B.Sc., Botanical Laboratories, The University, Sheffield (1920).
9. Baxter, Mr W. R., 19, Ashton Terrace, Hillhead, Glasgow, W. (1919).
10. Bayliss, Miss Jessie Sproat, D.Sc. (B'ham), B.Sc. (Lond.). (See Mrs J. S. Bayliss Elliott.)
11. Beer, Mr Rudolph, B.Sc., Ministry of Agriculture, Pathological Laboratory, Kew (1919).
12. Bellerby, Mr William, 8, Burton-stone Lane, York (1917).
13. Biffen, Professor R. H., M.A., F.R.S., 136, Huntingdon Road, Cambridge (1899).
14. Bintner, Mr J., Ingénieur Horticole, Helmdange, Gr. Duché de Luxembourg (1919).
15. Blackman, Professor V. H., M.A., F.R.S., Imperial College of Science, South Kensington, London, S.W. 7 (1900).
16. Blackwell, Miss Elsie M., M.Sc., Botanical Laboratories, The University, Liverpool (1917).
17. Blagden, Mr Charles Otto, 57, Earl's Court Square, London, S.W. 5 (1910).
18. Bloom, Rev. James Harvey, 601, Bank Chambers, 329, High Holborn, London, W.C. (1915).
19. Borthwick, Mr A. W., D.Sc., O.B.E., Royal Botanic Garden, Edinburgh, and 46, George Street, Edinburgh (1911).

20. Boston, The Mycological Club, c/o Miss Jennie F. Conant, 26, Prospect Street, Melrose, Mass., U.S.A. (1906).
21. Boyd, Mr D. A., St Clair, Caledonia Road, Saltcoats, N.B. (1906).
22. Brand, Mr Frederick J., High Beech Road, Loughton, Essex (1918).
23. Brierley, Mr William B., Institute of Plant Pathology, Rothamsted Experimental Station, Harpenden (1919).
24. British Museum, The Trustees of, Cromwell Road, South Kensington, London, S.W. 7 (1914).
25. Brooks, Mr F. T., M.A., The Botany School, Cambridge (1907).
26. Bruxelles, Jardin Botanique de l'Etat, c/o M. P. van Aerdschot (1911).
27. Bryce, Mr G., B.Sc., Royal Botanic Gardens, Peradeniya, Ceylon (1915).
28. Buckley, Mr W. D., 27, Bengal Road, Ilford, Essex (1916).
29. Buller, Professor A. H. R., D.Sc., Ph.D., F.R.S.C., University of Manitoba, Winnipeg, Canada (1911).
30. Calder, Mr Ronald B., B.A. (Cantab.), B.Sc., Lecturer in Botany, East London College, Mile End Road, London, E. 1 (1920).
31. Carr, Professor J. W., M.A., University College, Nottingham (1896).
32. Cartwright, Mr K. St S., Rothbury, Hay, Hereford (1913).
33. Cayley, Miss Dorothy M., John Innes Horticultural Institute, Mostyn Road, Merton, Surrey (1913).
34. Cheesman, Mr W. Norwood, J.P., F.L.S., The Crescent, Selby (1896).
35. Chicago, The Library, University of, Ill., U.S.A. (1914).
36. Chipp, Mr T. F., B.Sc., F.L.S., Assistant Director, Botanic Gardens, Singapore (1919).
37. Clarke, Miss H., M.Sc., 45, Beaconsfield Road, Seaforth, Liverpool (1917).
38. Clarke, Dr Henry, Cournswood, North Dean, High Wycombe (1919).
39. Clarke, Mr James Jackson, 25, Norfolk Road, London, N.W. 8 (1920).
40. Cleland, Mr J. Burton, M.D., Professor of Pathology, University of Adelaide, South Australia (1918).
41. Coimbatore, The Librarian, Agricultural College, South India (1918).
42. Collins, Miss Florence, The School of Gardening, Clapham, nr Worthing, Sussex (1920).
43. Cooper, Miss Charlotte A., Hillside Cottage, California Road, Bushey Heath, Herts (1911).

44. Cornell University Library, Ithaca, New York (1920).
45. Cotton, Mr Arthur D., F.L.S., Ministry of Agriculture, Pathological Laboratory, Kew, Surrey (1902).
46. Curtis, Miss Kathleen M., M.A., c/o Bank of New Zealand, 1, Queen Victoria Street, London, E.C. 4 (1917).
47. Darbishire, Professor O. V., B.A., Ph.D., University College, Bristol (1913).
48. Dastur, Mr J. F., M.Sc., Imperial Agricultural Research Institute, Pusa, Bengal, India (1920).
49. Drinkwater, Mr Harry, M.D., C.M.Edin., M.R.C.S.Eng., F.R.S.E., F.L.S., J.P., Lister Lodge, Wrexham (1910).
50. Edwards, Mr W. H., Curator, The Museum, Birmingham (1896).
51. Elliott, Dr W. T., L.D.S., R.C.S., F.Z.S., Arden Grange, Tanworth-in-Arden, Warwickshire (1913).
51.* Elliott, Mrs J. S. Bayliss, D.Sc., Arden Grange, Tanworth-in-Arden, Warwickshire (1911).
52. Ellis, Mrs Annis, 13, Stoney Hey Road, New Brighton, Cheshire (1917).
53. Essex Field Club, c/o Mr Percy Thompson, F.L.S., Essex Museum of Natural History, Romford Road, Stratford, Essex, E. 15 (1919).
54. Evans, Mr William, F.R.S.E., 38, Morningside Park, Edinburgh (1911).
55. Eyre, Miss J. C., Ippelpen, Newton Abbot, Devon (1915).
56. Fenton, Mr E. W., Botanical Department, Seale-Hayne Agricultural College, Newton Abbot (1920).
57. Finlayson, Mr Raymond A., F.L.S., The Parsonage Farm, Downton, Wilts (1910).
58. Fitzgerald, Rev. H. P., F.L.S., Lidwells, Goudhurst S.O., Kent (1896).
59. Franklin, Hon. Mrs, Glenalla, Ray, Letterkenny, co. Donegal (1919).
60. Fraser, Miss H. C. I., D.Sc. (See Dame Helen Gwynne-Vaughan.)
61. Fynes-Clinton, Rev. C. E., M.A., St James' Vicarage, Leyland, Preston (1917).
62. Gardner, Captain Frederic, c/o Lloyd's Bank, Jersey, Channel Islands (1898).
63. Goodwin, Mr D. P., Oakden, Kidderminster (1902).
64. Gould, Mr F. G., Elmhurst, Church Hill, Loughton, Essex (1918).
65. Green, Col. C. Theodore, A.M.S., M.R.C.S.Eng., L.R.C.P. Lond., F.L.S., 31, Shrewsbury Road, Birkenhead (1901)
66. Green, Mr E. Ernest, F.Z.S., F.E.S., Way's End, Camberley, Surrey (1917).

67. Grinling, Mr C. H., B.A., 26, Bedford Grove, Woolwich, S.E. 18 (1913).
67.* Gwynne-Vaughan, Dame Helen, D.B.E., D.Sc., F.L.S., LL.D., 93, Bedford Court Mansions, London, W.C. 1, and Birkbeck College, Chancery Lane, London, W.C. 2 (1906).
68. Hadden, Mr Norman G., Breezy Bank, West Porlock, Somerset (1911).
69. Harrison, Mr H. W., c/o 2, Elson Road, Formby, Lancs. (1913).
70. Harrison, Mrs E., c/o 2, Elson Road, Formby, Lancs. (1913).
71. Harvey, Mrs Cecily D., Barwick-in-Elmet Rectory, near Leeds (1910).
72. Hastings, Mr Somerville, M.S., F.R.C.S., 43, Devonshire Street, Portland Place, London, W. 1 (1913).
73. Hawley, Sir H. C., Bart., Holly Mount, Hurst Wood, Buxted, Surrey (1907).
74. Hibbert-Ware, Miss Alice, 3, Chaucer Road, Wanstead, E. 11 (1911).
75. Hildyard, Mr F. W., 14, Lambridge, Bath (1913).
76. Hiley, Mr Wilfred E., M.A., Research Institute, School of Forestry, Oxford (1913).
77. Holmes, Mr E. Morell, F.L.S., F.R.H.S., Ruthven, Sevenoaks, Kent (1906).
78. Holt, Mr W. H., 17, Ashville Road, Birkenhead (1914).
79. Howard, Mr H. J., F.R.M.S., 94, Rosary Road, Norwich (1918).
80. Hughes, Mr G. C., Chesterton, Bicester, Oxon (1898).
81. Huish, Mr Charles Henry, F.R.M.S., The Limes, London Road, Redhill, Surrey (1913).
82. Illinois, The Library, University of, Urbana, Ill., U.S.A. (1920).
83. Jack, Mr H. W., B.Sc., B.A., Agricultural Instructor, Department of Agriculture, Kuala Lumpur, Federated Malay States, and Waterloo Place, Cork (1913).
84. Jewson, Miss S. T., B.Sc., Institute of Plant Pathology, Rothamsted Experimental Station, Harpenden (1919).
85. Johnson, Mr J. W. Haigh, M.Sc., F.L.S., 71, Northgate, Wakefield (1919).
86. Johnstone, Mr R. B., 134, Cambridge Drive, Glasgow (1908).
87. Jones, Mr Robert Fowler, 8, Lendal, York (1918).
87.* Kidd, Mrs Franklin, The Botany School, Cambridge (1919).
88. Knight, Mr H. H., M.A., The Lodge, All Saints Villas, Cheltenham (1914).

89. Linnean Society of London, Burlington House, Piccadilly, London, W. 1 (1919).
90. Lister, Miss Gulielma, F.L.S., Leytonstone, Essex, and Highcliff, Lyme Regis (1903).
91. Lister, Mr A. B., D.I.C., B.Sc. (Lond.), Experimental and Research Station, Turner's Hill, Cheshunt, Waltham Cross, Herts (1916).
92. Lloyd, Mr C. G., The Lloyd Library and Museum, 224, West Court Street, Cincinnati, Ohio, U.S.A. (1907).
93. Macfie, Dr John William Scott, M.A., D.Sc., 21a, Alfred Street, Liverpool (1900).
94. Mackenzie, Mr D., Afton, Busby, N.B. (1900).
95. Main, Mr Robert, 1, Roslyn Avenue, Low Fell, Gateshead (1918).
96. Maire, Dr René, D.Sc., Professeur à la Faculté des Sciences de l'Université, Algers (1907).
97. Maitland, Mr T. D., Chief of Economic Plant Division, Agricultural Department, Nairobi, British East Africa (1916).
98. Marmont, Mr Basil P., Windsoredge House, Inchbrook, near Woodchester, Glos. (1908).
99. Marriott, Mr St John, 37, Owenite Street, Abbey Wood, S.E. (1920).
100. Mason, Mr F. A., F.R.M.S., The Laboratory, 3, Queen's Square, Leeds, and 29, Frankland Terrace, Leopold St, Leeds (1912).
101. McCutcheon, Mr William, B.A., B.Sc., Goulburn, 89, Argyle Road, Saltcoats, N.B. (1920).
102. Menzies, Mr James, 117, Scott Street, Perth (1917).
103. Minnesota, The Library, University of, Minneapolis, U.S.A. (1915).
104. Missouri, The Botanical Garden, St Louis, Mo., U.S.A. (1902).
105. Miyabe, Dr Kingo, Professor of Botany, Hokkaido Imperial University, Sapporo, Japan (1919).
106. Montague, Mrs A., Penton, Crediton, N. Devon (1898).
107. Morris, Mr T. N., B.A., Dip. Agr. (Cantab.), St John's College, Cambridge (1919).
108. Mysore, The Library, University of (1919).
109. Nederlandsche Mycologische Vereeniging, c/o M. H. A. A. van der Lek, Bennekom, Holland (1920).
110. Newcastle-upon-Tyne Literary and Philosophical Society (1902).
111. Newman, Mr Leslie F., M.A., F.L.S., Dip. Agr. (Cantab.), St Catharine's College, Cambridge (1906).
112. New York Botanical Garden, Bronx Park, New York, U.S.A. (1904).

113. Nicholson, Mr Charles, F.E.S., 35, The Avenue, Hale End, Chingford, N.E. (1916).
114. Nicholson, Mr W. E., Lewes (1913).
115. Noel, Miss E. F., F.L.S., 37, Moscow Court, London, W. (1913).
116. Ogle, Mr B. S., Hill House, Steeple Aston, Oxon. (1904).
117. Oke, Mr Alfred William, B.A., L.L.M., F.G.S., F.L.S., 32, Denmark Road, Hove (1908).
118. O'Loughlin, Miss Bessie, Rocklands, Wallasey, Cheshire (1913).
119. Osborn, Professor T. G. B., M.Sc., Adelaide University, South Australia (1910).
120. Overeem, Mr C. Van, Mycological Museum, Weesp, Holland (1920).
121. Overton, Mr H., Newlands, Boswell Road, Sutton Coldfield, Birmingham (1920).
122. Owen, Miss M. N. (See Mrs Franklin Kidd.)
123. Paul, The Very Rev. David, LL.D., D.D., 53, Fountainhall Road, Edinburgh (1899).
124. Paulson, Mr Robert, F.L.S., F.R.M.S., Glenroy, Cecil Park, Pinner, Middlesex (1918).
125. Peacock, Dr H. G., Hareston Lodge, Torquay (1896).
126. Pearson, Mr Arthur A., F.L.S., 59, Southwark Street, London, S.E. 1 (1911).
127. Peck, Mr A. E., Tosti, 20, Avenue Road, Scarborough (1918).
128. Peltereau, Monsieur E., Vendôme, Loir-et-Cher, France (1909).
129. Perceval, Mr Cecil H. Spencer, Longwitton Hall, Morpeth (1901).
130. Perthshire Society of Natural Science, c/o James Winter (Hon. Treas.), 35, George Street, Perth (1919).
131. Petch, Mr T., B.A., B.Sc., Royal Botanic Gardens, Peradeniya, Ceylon (1911).
132. Pethybridge, Dr G. H., B.Sc., Department of Agriculture and Technical Instruction for Ireland, Royal College of Science, Upper Merrion Street, Dublin (1919).
133. Phillips, Professor Reginald W., M.A., D.Sc., F.L.S., University College, Bangor (1911).
134. Plowright, Mr Charles Tertius Maclean, B.A., M.B., King Street, King's Lynn (1901).
135. Potter, Professor M. C., Sc.D., M.A., F.L.S., Armstrong College, Newcastle-upon-Tyne (1896).
136. Potts, Mr George, Benthall House, Broseley, Salop (1910).
137. Price, Mr S. Reginald, B.A., Fernleigh, Wellington, Somerset (1911).

138. Priestley, Professor J. H., B.Sc., F.L.S., Botanical Department, University of Leeds (1912).
139. Priestley, Mrs Marion E., 10, Monk Bridge Road, Headingley, Leeds (1919).
140. Ramsbottom, Mr J., M.A., F.L.S., O.B.E., British Museum, Cromwell Road, South Kensington, London, S.W. 7 (1910).
141. Ramsbottom, Mr J. K., c/o Geo. Munro, Ltd., 4, Tavistock Street, Covent Garden, W.C. 2 (1914).
142. Rayner, Mr J. F., Swaythling, Southampton (1902).
143. Rea, Mrs E. A., 6, Barbourne Terrace, Worcester (1896).
144. Richards, Mr R. M., A.R.C.S., The Laboratory, Caledonia Estate, Province Wellesley, Straits Settlements (1915).
145. Roberts, Mrs A. W. Rymer, The Common, Windermere (1920).
146. Robson, Mr R., M.Sc., F.Z.S., Writtle, Chelmsford, Essex (1914).
147. Rushton, Mr W., A.R.C.S., D.I.C., St Mary's Hospital Medical School, Paddington, and 90, Sugden Road, Clapham Common, London, S.W. 11 (1914).
148. Sampson, Miss K., B.Sc., Economic Botanist, Plant Breeding Station for Wales, University College, Aberystwyth (1920).
149. Saunders, Miss E. R., F.L.S., Newnham College, Cambridge (1913).
150. Searle, Mr G. O., B.Sc. Agric. (Lond.), Research Botanist, Linen Industry Research Association, Glenmore House, Lambeg, Lisburn, Ireland (1920).
151. Selborne Society, 42, Bloomsbury Square, London, W.C. 1 (1913).
152. Sharpe, Mr C. J., Brambleside, Manor Road, Sidcup (1905).
153. Simon, Monsieur Eugène, 16, Villa Saïd, Paris (1906).
154. Small, Mr W., M.A., Government Botanist, Department of Agriculture, Kampala, Uganda (1915).
155. Smith, Miss Annie Lorrain, F.L.S., 20, Talgarth Road, West Kensington, London, W. 14 (1899).
156. Smith, Miss K. E., 64, Coton Road, Nuneaton (1913).
157. Smith, Mr Thomas, 25, Lyme Street, Stockport (1918).
158. Stoward, Dr F., 69, Tate Street, Leederville, Western Australia (1914).
159. St Paul, Minn., U.S.A., The Library, Department of Agriculture University Farm (1920).
160. Sutherland, Mr G. K., M.A., D.Sc., 10, Bank Parade, Preston (1914).

161. Swanton, Mr E. W., A.L.S., Brockton, Haslemere (1899).
162. Swedish Academy of Sciences, Royal.
163. Tabor, Mr Richard John, B.Sc., F.L.S., Imperial College of Science and Technology, South Kensington, London, S.W. 7 (1914).
164. Tatum, Mr E. J., Salisbury (1896).
165. Taylor, Miss Beatrice Katharine, 98, Cheyne Walk, Chelsea, London, S.W. 3 (1910).
166. Temperley, Mr Nicholas, 4, Carlton Terrace, Low Fell, Gateshead-on-Tyne (1918).
167. Thomas, Mr H. Hamshaw, M.B.E., M.A., The Botany School, Cambridge (1910).
168. Thomson, Miss Mary R. H., c/o The Chief, Division of Botany, Box 994, Pretoria (1917).
169. Toronto, The Library, University of (1910).
170. Tothill, Lieut. Vincent, R.A.M.C., Ilketshall, St Andrew, Bungay, Suffolk (1912).
171. United States, Department of Agriculture (1907).
172. Vines, Professor S. H., M.A., D.Sc., F.R.S., Headington Hill, Oxford (1915).
173. Wager, Dr H., F.R.S., F.L.S., Hendre, Horsforth Lane, Far Headingley, Leeds (1896).
174. Wakefield, Miss E. M., F.L.S., Herbarium, Royal Botanic Gardens, Kew (1911).
175. Watkin, Mr J., 38, Park Avenue, Oswestry (1909).
176. Wheldon, Mr H. J., Cubbington, Leamington Spa (1918).
177. Whetzel, Professor H. H., Cornell University, Ithaca, New York (1914).
178. Wilson, Mr A. E., Southey House, College Green, Bristol (1920).
179. Wilson, Mr Malcolm, D.Sc., A.R.C.S., F.L.S., Royal Botanic Garden, Edinburgh (1912).
180. Wiltshire, Mr S. P., Research Station, Long Ashton, Bristol (1920).
181. Woolhope, The, Naturalists' Field Club, Hereford, c/o Mr C. S. Scobie, 2, Offa Street, Hereford (1896).

*Elected since the above went to Press.*

182. Birmingham Natural History and Philosophical Society (1920).
183. Cutting, Mr E. M., M.A., F.L.S., The Botanical Department, University College, Gower Street, London, W.C. 1 (1920).
184. Dowson, Mr W. J., F.L.S., Nairobi, East Africa Protectorate, and Crosslee, Heathside Crescent, Woking (1920).
185. Rea, Miss M. W., Salem House, Sydenham, Belfast, Ireland (1920).

# RULES.

*Society's name and objects.*

1. The Society shall be called "The British Mycological Society," and its object shall be the study of Mycology in all its branches.

*Members of Society.*

2. The Society shall consist of Honorary Members, Foundation Members and Ordinary Members; the number of Honorary Members shall be limited to 20, and that of Foundation Members to 100*, but the number of Ordinary Members shall be unlimited.

*Honorary Members.*

3. Honorary Members shall be persons of pre-eminence in Mycology, or who have rendered special service to the Society.

*Foundation Members.*

4. Foundation Members shall be those Members or Societies who joined the Society previous to the limit of 100 Members having been attained*.

*Officers.*

5. The Officers of the Society shall consist of a President, one or more Vice-Presidents, Treasurer, Secretaries, and Editor or Editors. They shall be elected annually at the Annual General Meeting of the Society.

*Government of Society.*

6. The government of the Society shall be vested in a Council, which shall consist of the President and other Officers for the time being, together with two or more other Members who shall be elected annually at the General Meeting, and one-half of whom shall retire each year and not be eligible for immediate re-election. The Members to retire shall be those who have been longest in office or, in case of equality, shall be determined by ballot. Ex-Presidents are *ex officio* Members of the Council.

Every Meeting of the Council shall be duly summoned by the Hon. Secretary by at least seven days' notice in writing to each Member of the Council.

* The limit of 100 Foundation Members was reached 22nd Oct., 1903.

*Period of Office.*

7. The Officers and Council shall hold office as from the 1st of January following their election.

*Election of Members.*

8. Honorary Members shall only be elected at a Meeting of the Society by a majority of the Members then present.

All Ordinary Members shall be proposed and seconded respectively by existing Members, who shall sign a certificate (see appendix) of recommendation, one at least of the proposers so certifying from personal knowledge. Every candidate for election shall sign an undertaking to abide by the Rules if elected (see appendix). They shall be elected by a majority of the Members present at any meeting of the Society or by the President and Officers of the Society.

*Subscription.*

9. All Ordinary Members and Societies shall pay an annual subscription of ten shillings, and Foundation Members five shillings, due on the 1st of January in each year. Honorary Members shall be exempt from any annual subscription.

Any Member wishing to retire from the Society shall give notice to the Hon. Secretary or Treasurer in writing before the 1st of December of the previous year.

*Meetings.*

10. The Society shall hold one or more Meetings annually, at a place and time determined by the Members at the preceding Annual General Meeting, or by the Council. The Annual General Meeting for the election of Officers and the transaction of other business shall coincide with the Autumn Foray.

*Accounts.*

11. At the Annual General Meeting of the Society in each year the Hon. Treasurer shall present duly audited accounts.

*Alteration of Rules.*

12. The Rules shall not be altered except by a two-thirds majority of the Members present at an Annual General Meeting. A printed copy shall be sent to every Member of the Society on election, and in the event of alteration to all Members.

# APPENDIX.

*Form of proposal for Ordinary Membership of the British Mycological Society.*

.....

*of* .....

.....

being desirous of becoming an Ordinary Member of the British Mycological Society, we, the undersigned Members of the Society, certify that we consider h to be a desirable Member of the Society, and beg to recommend h for election.

Dated this day of 19

.....(From personal knowledge).

*Certificate to be signed by the Candidate.*

I hereby certify that I desire to become an Ordinary Member of the British Mycological Society and that I will abide by the Rules if elected.

.....

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